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The Amateur Astronomer as a Community Teacher
The Advertisements of J. A. Whipple
American Astronomers Report
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NAVAL RESEARCH LABORATORY ECLIPSE EXPEDITION

THE Naval Research Laboratory is sending an expedition of about a dozen scientists to Attu, the westernmost island on the Aleutian chain, in order to observe the total eclipse of the sun on September 12, 1950. This eclipse is similar to the eclipse which crossed Canada and Maine on August 31, 1932, an interval of a saros earlier. Totality will last 73 seconds, and occurs at $3^h\ 42^m\ 41^s$ Universal time.

The proposed site at Attu is on Alexai Point, at 52° 49′ north latitude and 173° 18′ east longitude, within five miles of the center line of totality.

Very little is known about the electronic density and temperature gradients in the solar atmosphere. A previous eclipse measurement in the 3-cm. region made by the Naval Research Laboratory at the time of the May, 1947, eclipse has shown that solar eclipse observations at centimeter wave lengths offer a good method of determining these gradients. The diameter of the sun for radio radiation is greater than the visible sun and increases with increasing wave length. Eclipse observations at several wave lengths will determine the relative effective diameters of the sun at these various wave lengths and will aid in assigning electronic density and temperature gradients.

The moon at mid-totality will obscure the solar atmosphere up to an altitude of 12,600 kilometers above the visible surface, which is at the base of the corona and the top of the chromosphere. The integrated intensity of the solar radio emission during the eclipse will be measured at four wave lengths: 0.85 centimeter, 3.15 and 10.7 centimeters, and 64.5 centimeters. (A wave length of one centimeter equals a frequency of 3×10^{10} cycles per second.) This range of wave lengths broadly covers the short wave end of the radio spectrum. Eclipse observations of longer wave emission are less interesting, because the diameter of the source is too large compared to the moon.

On the basis of present theories, this is a convenient eclipse magnitude for studying the chromosphere, since the 0.85- and 3.15-cm. emissions arise predominantly in the chromosphere, and the 64.5-cm. emission originates in the corona, while the 10.7-cm. radiation comes from both regions. Therefore, this eclipse is particularly valuable for testing the thermal emission theory of radio waves on the basis of various assumed electron density and temperature gradients in the solar atmosphere. In addition, the extension and the intensity spectrum of discrete regions on the solar disk of enhanced radio emission can be studied.

Although it is more than likely that the sky will be overcast, the Gardner corona camera having an 8-inch objective and 14-foot focal length will also be set up, so that short-exposure corona photographs may be taken to aid in the analysis of the radio data. The presence of overcast will fortunately not affect the radio observation of the eclipse.

Sky and TELESCOPE

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LETTERS

Sir:

Your note entitled "Too Many Leos," on page 133 of the April, 1950, number, impels me to come to the defense of our lions, lest some reader may infer that they are unfriendly or have a taste for astronomers. South African lions are extremely particular about dietary matters, and in any case they are not naturally inclined to interfere with the activities of humans, if these humans will only leave them in peace. I speak from many years' experience of our lions in the Transvaal low veld and in the Rhodesias.

I do recall that astronomical enterprise on my part was once seriously hampered — and not by lions, but by natives. Conducting observations in the native territory called the Transkei, inhabited by the so-called Red Kaffirs (from their habit of daubing themselves with ochre), I was comfortably installed with a theodolite, radio receiver, et al, on a hilltop one early morning. A troop of elderly Kaffirs, led by a very old man, approached. They bore knobkerries (bludgeons to you) and advanced in a threatening manner.

I greeted the old leader in his own tongue and asked him what caused him to advance so unceremoniously. He replied that he believed I had come in connection with a war the white people were preparing against his folk. Pointing to my theodolite and all the paraphernalia, he said: "When I was a young man, one just like you came here and placed upon this hill just such a machine, which blinked and sent messages by starlight. And then followed the war, wherein many of my people died. We have come to smash this machine, and you must leave our country." He looked quite determined, and I was worried. But I moved over to the theodolite, turned the telescope objective upon him, and announced, "This eye will now gaze into your soul and I will see through it what are your inmost thoughts. Perhaps, even, it will bring you ill fortune." The old fellows scooted down the hill, shouting to each other of the "evil eye."

So, please, less emphasis on, or implications about, our lions. Our cities and native reserves are a long way more dangerous than is our veld.

S. O. EKLUND
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BACK COVER: The spiral galaxy M94, NGC 4736, photographed with the 60-inch reflector of Mount Wilson Observatory on May 12, 1926, exposure three hours. This shows the inner portions of the galaxy, and the picture on page 266 reveals more extensive spiral arms. Mount Wilson photo. (See In Focus.)

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Is the Milky Way a Spiral Galaxy?

By Otto Struve, *University of California, Berkeley*

THIS QUESTION is not new. It intrigued astronomers as soon as they began to suspect that the larger spirals consist of ordinary stars. But until recently the answer was based upon pure speculation.

Largely through the work of W. Baade we have come to realize that there is a remarkable similarity between our Milky Way and the Andromeda nebula, M31. Both are stellar systems of similar dimensions, having about the same number of stars and possessing the same general structure. Each has a small nucleus with moderate flattening containing stars of Baade's Population II; a large disk-shaped system of stars belonging to Population I, interspersed with dense clouds of gas and dust; and a large, almost spherical, system of low density which consists of stars of Population II. It is reasonable to inquire whether the conspicuous spiral structure of the Andromeda nebula has also a counterpart in the Milky Way.

Let us try to think where the solar system would be located if it were in the Andromeda galaxy. The distance between the sun and the center of our galaxy is about 25,000 light-years. Such a distance, if observed in the Andromeda nebula, 720,000 light-years away, would subtend an angle of almost two degrees. The usual photographs of the nebula show that *bright* spiral arms can be seen only to distances of the order of 1½ degrees from the nucleus. But the *bright* arms do not indicate the true dimensions of the galaxy. H. Shapley discovered from a study of long photographic exposures that the nebula extends, as a faint, roughly spherical glow, to a distance of at least two or 2½ degrees from the nucleus, while J. Stebbins and A. E. Whitford, in 1934, found a photoelectrically measurable surface brightness, above that of the night sky, at a distance of three or four degrees from the center, in the central plane of the system.

Thus, the location of the sun in M31 would correspond to a point far outside the true spiral arms (Fig. 1). Do we have any real evidence that these faintly glowing, outermost regions of the Andromeda nebula really have a spiral structure?

It is difficult to be certain. Recently, estimates have been made, by A. G. Mowbray and Ruth Beecher independently, of the surface brightness of our galaxy, near the sun, if observed from a distant point at about the same angle under which we observe the central plane of the Andromeda nebula (about 15 degrees). The brightness would correspond to one star of apparent magnitude 23 per square second — an exceedingly small quantity, and one that can be measured only with great difficulty. But according to N. U. Mayall, Baade, and others, there are many bright gaseous nebulae in the outermost regions of the spirals, and we know that these formations, like the obscuring clouds, are closely associated with the presence of stars of Population I. In fact, the bright gaseous nebulae owe their light to the excitation produced by the ultraviolet radiations of the blue stars — those of spectral classes *O* and early *B*. And we also know that these blue stars are typical inhabitants of the spiral arms. Hence, we are probably justified in attributing a spiral structure to these "invisible" fringes of the galaxies.

And now let us examine what evidence there is for believing that the Milky Way, in the neighborhood of the sun, has a spiral structure. There are many different opinions, and it is difficult to choose among them.

We turn first to the star counts. After R. J. Trumpler's discovery of interstellar absorption in 1930, it became clear, through the work of B. J. Bok and others, that what we thought was a general decrease of star density in all directions from the sun was largely spurious; and that in reality the stars in the neighborhood of the sun form a small condensation. This *local cluster* is surrounded by a wide field of roughly uniform density, slowly increasing in the direction of the galactic center in Sagittarius and decreasing in the opposite or anticenter direction.

Most of the conspicuous star clouds in our sky are not real groupings of stars, but merely appear as such because the heavy absorption of neighboring dust clouds makes them stand out against the background of these darker regions. The "star-counting circuit" organized by Bok some years ago among his former pupils and associates has, for the most part, elucidated the distribution of the dust clouds and stars in the immediate vicinity of the sun, and has demonstrated that it is almost futile to attempt to unravel the large-scale structure of our galaxy, at great distances from the sun, by investigating only regions near the plane of the Milky Way.

An entirely different approach to the problem of the distribution of distant stars was made in 1937 and 1938 by M. Vashakidze and J. H. Oort, respectively. They depended mostly upon star counts at high galactic latitudes, where the interstellar clouds of absorbing particles are not so troublesome. Of course, in doing so they deliberately abandoned any attempt to find the distribution of stars in the galactic plane itself. But this loss was more than compensated by the smooth run of the surfaces of equal star density which they found at angles greater than about 15 degrees above and below the galactic plane.

Fig. 2 shows the results obtained by Oort. The diagram represents a vertical section across the Milky Way, along a line joining the sun and the galactic center, which lies about 25,000 light-

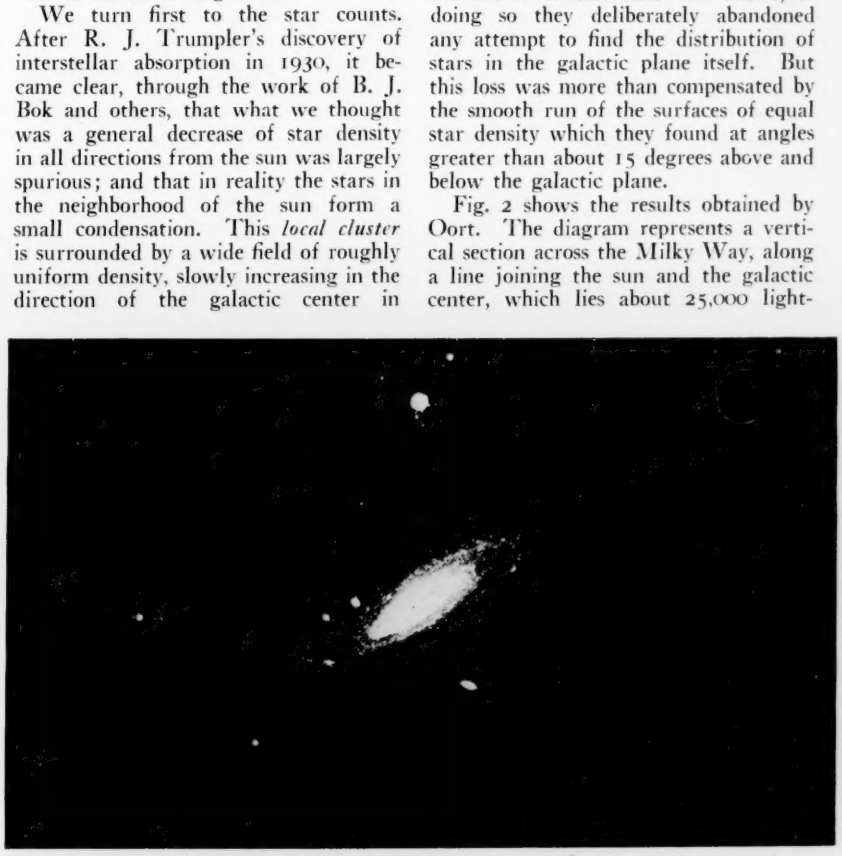


Fig. 1. The circles on this photograph of the Andromeda galaxy, M31, indicate regions with surface brightness about equal to that in our galaxy at the position of the sun relative to the galactic center.

years toward the right side of the diagram. The smooth lines represent the surfaces of uniform star density. Because of the difficulty with the dust clouds near the galactic plane these lines are not actually observed where they cross the central line. But Oort indicated their probable courses by connecting with dashed lines branches of equal density above and below the plane.

We observe the general diminution of star density at great distances from the central plane: 3,000 light-years above and below the sun the density is only a few hundredths of that in our immediate vicinity. We notice also the strong slant of the lines, at large distances, indicating a thickening of the stellar system in the direction of the central bulge in Sagittarius. This is due to the lens-shaped form of the galaxy. There are two condensations near the galactic plane. One, at a distance of about 5,000 light-years, is in the direction of the galactic center and reaches a star density of at least three times that of our vicinity. The other, somewhat less pronounced, is in the opposite direction, also about 5,000 light-years away. Neither condensation can have any direct relation to the galactic nucleus, because the distances are too small. But it is tempting to consider them as the cross-sections, in the plane of our diagram, of two spiral arms, both running approximately at right angles to the plane of the paper.

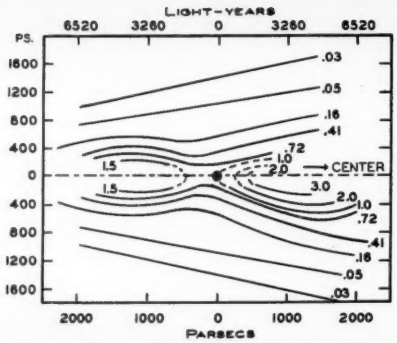


Fig. 2. The distribution of star densities in a plane at right angles to the galactic equator, according to J. H. Oort, of Leiden Observatory.

Fig. 3. The Whirlpool nebula, M51, in Canes Venatici. The central portion is NGC 5194, and the condensation below is NGC 5195. Mount Wilson Observatory photograph.

Are we certain that these two condensations are real? Fortunately we have corroborative evidence. B. V. Kukarkin found that the distribution of the long-period (Mira Ceti) variables, forming a greatly flattened system, also shows a conspicuous condensation in the direction of the galactic center, while the distribution of the galactic cluster-type variables, forming a spherical system, shows some vague indications of condensations on both sides of the sun. There are similar indications in the work of Bok, who has called attention to the fact that despite the presence of the local cluster we appear to be located in a region of abnormally small star density.

A particularly interesting though admittedly speculative solution to our problem has recently been proposed by P. P. Parenago, and I shall here follow his treatment, without attempting to present the views of other equally competent workers.

Let us assume that the condensations in Fig. 2 are the cross-sections of two adjoining spiral arms. What can we do next to clarify our picture of the Milky Way? In Fig. 3 we see a typical spiral galaxy, M51 in Canes Venatici. We notice that there is a small, spherical nucleus, from opposite sides of which emanate two distinct spiral arms. If we follow each of these arms, we discover a remarkable property that is characteristic of many spirals.

Select an arbitrary point on the arm and draw one straight line toward the center and another (a tangent) to denote the direction of the arm at that point. The angle between the two lines is not 90° (it would be 90° if the arm were a circle, not a spiral), but is either more or less, depending upon the direction in which we agree to measure these angles. Extensive research has shown that in different spirals the angle may be different, but in any given spiral it is approximately the same, no matter where on the spiral arms we draw the representative point (Fig. 4). C. G. Danver, at Lund, has shown that this property is fairly common among spirals.

On the average the characteristic angle θ is 106°, but for individual objects it may be as large as 126° or as small as 94°. There are, of course, many departures from the simple mathematical form predicted by the theory of a spiral whose characteristic angle is a constant. For one thing, we have to allow for various amounts of foreshortening because of the different orientations of the spirals. But Danver believes that despite this and other complications the "logarithmic spiral," as it is called, most nearly represents the observed shapes of the spiral galaxies. Two predicted curves of such spirals with different characteristic angles (denoted in Danver's work by the letter μ) are shown in Fig. 5.

Suppose that the diagram of Fig. 2 represents a cross-section through an object similar to that of the spiral galaxy in Fig. 3. If the condensation nearest

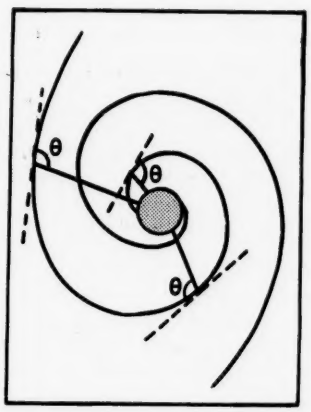


Fig. 4. A schematic representation of a spiral galaxy. The angle θ is approximately the same at every point of the two arms.

to the galactic center is the cross-section of one spiral arm, then the other condensation, on the left in Fig. 2, must represent a cross-section of the other spiral arm, and not a part of the next convolution of the first arm. In most real photographs we see that the spiral arms succeed one another at approximately equal distances from the center. Hence, we may assume that the next convolution of the first spiral arm will occur at about 10,000 light-years to the left of Oort's left-hand condensation. This condensation has not been observed. But if it were, its distance from the sun would be something like 15,000 light-years, in the direction of the anti-center. The separation of the two condensations, one visible and the other invisible, of two loops of the *same* spiral arm is therefore 20,000 light-years. This is sufficient to determine the characteristic angle of the spiral structure of our galaxy.

We may proceed by trial and error. Let us arbitrarily assume that the angle is 100°. Then, starting with a point

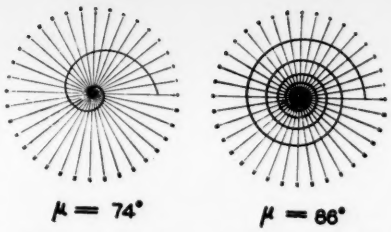


Fig. 5. Logarithmic spirals with different characteristic angles. The angle μ is $180° - \theta$.

corresponding to the invisible condensation of our first spiral arm (X, Fig. 6), we can trace out the spiral, keeping the angle between it and the direction toward the center always equal to 100°. Proceeding in this manner over a complete loop of 360°, we shall reach a point which should coincide exactly with Oort's right-hand condensation (V, Fig. 6). In reality our trial will show that we have made the angle slightly too large, and that consequently the spiral arm comes out too steep. Instead of hitting Oort's condensation at about 5,000 light-years from the sun we reach a point still farther from the sun and nearer the center.

We next repeat the experiment using a smaller angle, and thus by trial and error soon find that we satisfy both condensations (V and X) with an angle of approximately 98°. A spiral drawn in this way appears in Fig. 6, which is adapted from the work of Parenago.

The proposed figure of our Milky Way spiral has one uncertainty we have not as yet discussed. The question is whether the spiral arms approach the nucleus clockwise or counterclockwise. It is obvious that we could have made our drawing exactly in the same way as in Fig. 6 except that the spiral arms would appear to approach the nucleus in a clockwise instead of a counterclockwise direction.

Parenago proposes two independent ways of deciding upon the right direction. He first points out that the local cluster of stars surrounding the sun is conspicuously elongated in a direction *roughly* at right angles to the direction of the galactic center. But the elongation departs from the exact right-angle direction by about eight degrees — the elongation is in galactic longitudes 64°-244°, while the direction toward the galactic center in Sagittarius is 326°. Thus, the local cluster seems to share the characteristic angle of 98° which we have just found for the spiral arms. But in this case we are certain that the direction is such as to be consistent with the sense in which the spiral arms are drawn in Fig. 6.

This does not imply that the local cluster is a part of a major spiral feature of our Milky Way. On the contrary, it is probably one of the smaller branches that are often visible in other galaxies and that frequently (though not always) have the same characteristic angle as the rest of the spiral structure.

Another line of reasoning depends upon the observation of four distant Cepheid variables in Cygnus. These stars have already been investigated by Oort, and they are shown in Fig. 6 as small dots. Although their individual distances are not accurate, a mean value of approximately 30,000 light-years from the sun, in such a direction that the angle at the center of the galaxy between the sun and the variables is about 60 degrees, may be trusted. It can be shown that if these variables lie on one of the neighboring spiral arms of our galaxy the only consistent way of drawing the figure is that shown in Fig. 6.

Parenago points out that if his reconstruction of the Milky Way spiral is correct it must be regarded as a confirmation of the direction of rotation in extragalactic objects which B. Lindblad has championed for many years. An arrow in Fig. 6 shows the direction of galactic rotation in the vicinity of the sun, which is directly found from the observations. This rotation is of the

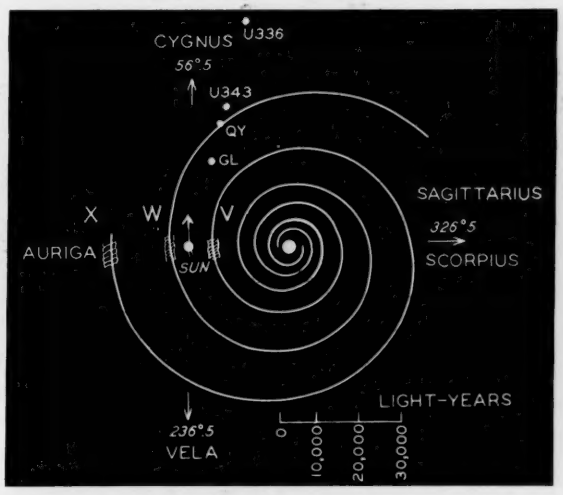


Fig. 6. The spiral structure of the Milky Way galaxy, adapted from the work of P. P. Parenago. Directions in galactic longitude are shown for several constellations, and the arrow at the sun represents the direction of its revolution around the galactic center. Four distant Cepheid variables in Cygnus are labeled.

type described by E. Hubble as having "leading" spiral arms, and is distinct from the type of rotation in which the spiral arms are believed to be "trailing" behind.

It is one of the most surprising paradoxes of astronomical research that the question of the direction of rotation has given, and is still giving, so much trouble to astronomers. Fig. 7 shows what we mean. At the top is a schematic representation of a spiral observed under an angle of 15 degrees, about that of M31. Let us suppose that the right-hand side of this object shows spectral lines displaced toward the violet, corresponding to a motion of approach. Let the left side be receding. Actual measurements of this phenomenon, based

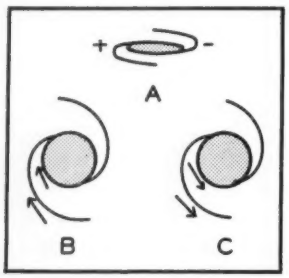


Fig. 7. The paradox of the rotation of a spiral galaxy. The plus sign indicates motion away from the observer.

upon the study of Doppler displacements, have been made by Mayall at the Lick Observatory as well as by others. However, we do not usually know whether the top or the bottom of the object, as seen in the sky, is closer to us. If the top is farther away, the observed motion corresponds to the case illustrated under B. If, however, the top is closer to us, then the sense of the rotation is that shown under C. In B the spiral arms are trailing. In C they are leading.

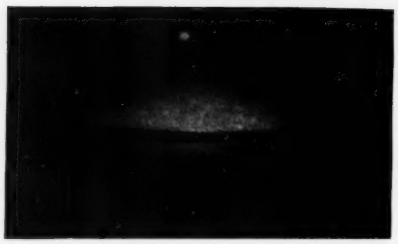


Fig. 8. NGC 4594, an edgewise spiral in Virgo, with an obscuring ring in its equatorial plane. Mount Wilson photo.

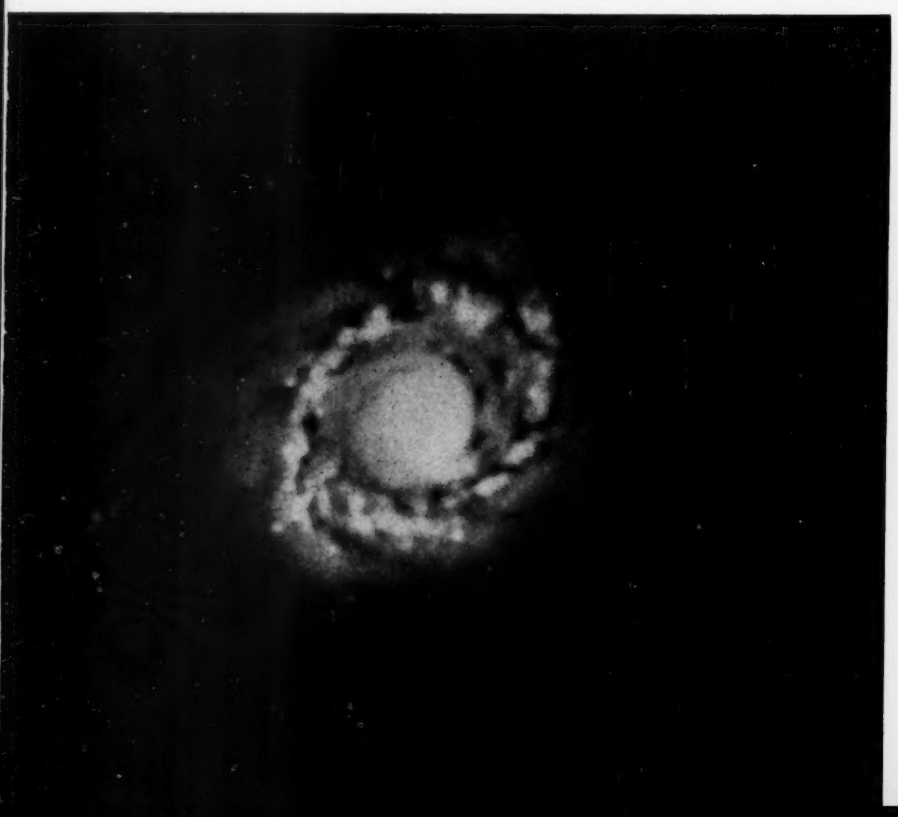
It might be thought that from the appearance of the structural details in modern photographs it would be easy to tell which side of a spiral seen partly from the edge is closer and which is farther away. In reality, a study of thousands of nebular photographs by Hubble has shown only a few in which it is possible to discern at the same time the geometrical arrangement of the spiral arms and their spatial orientation with respect to us. It is true that in many cases when a spiral object is observed edgewise we see a dark band along the equator, and this absorbing mass must be in front of the luminous object. However, almost invariably these objects fail to show sufficiently well-resolved spiral arms (Fig. 8). They merge into one another and we do not know which is which.

In the cases of the spiral NGC 3190 and a few other galaxies, Hubble succeeded in establishing that the direction of rotation as measured from the Doppler displacements almost certainly corresponds to the case of the "trailing" arms, but Lindblad has objected to Hubble's interpretation and has advanced certain reasons for thinking that the structure of the arms in NGC 3190 may be somewhat more complex than was thought probable at first.

Instead, he proposed a number of tests depending upon the absorption of light in different parts of spiral arms for deciding which side is the nearer one. He and his colleagues at Stockholm, Oehman and Brahde, have accumulated a varied amount of material supporting the contention that the rotation is usually with "leading" arms.

Astronomers who are not experts in this type of work will find it difficult to form an opinion regarding the opposing views of the two groups. From the observational point of view, Hubble's results on NGC 3190 and several other objects, supported by photoelectric measures of colors, by Stebbins, are strongly in favor of the "trailing" arm hypothesis. On the other hand, Lindblad's theoretical work, perhaps more so than his observational results, favors a rotation with "leading" arms.

This photograph of M94, taken February 20, 1912, 3½-hour exposure, shows a considerably larger extension of the spiral arms than does the back cover. Mount Wilson photo.



In Focus

IN Canes Venatici, near the Coma-Virgo region of galaxies, lies the spiral M94, NGC 4736, first observed by Méchain in the 18th century, and pictured on our back cover this month. Its position is at right ascension $12^h\ 48^m.5$, declination $+41°\ 24'$ (1950).

Visually it is of magnitude 8.4, photoelectrically 8.8, and photographically 9.5, an Sb type of spiral, at a distance of three million light-years. Its absolute magnitude is -17.2, indicating it to be one of the larger galaxies, similar to the Great Nebula, M31, in Andromeda.

This galaxy is described in Lick **Publications, XIII,** as having a very bright, large nucleus, from which spring many bright, closely packed whorls, forming an inner oval measuring about two by 1½ minutes of arc. The description further notes that there are fainter outer whorls, closely packed and rather uniform, extending the size to five by 3½ minutes of arc. In addition, it is said that fainter wisps of nebulosity extending from the brighter arms fill an area 30 minutes in diameter.

Inasmuch as the details of the outer arms do not show on the back-cover picture, another exposure, also taken with the Mount Wilson 60-inch, is reproduced here. Dr. N. U. Mayall, of Lick Observatory, has investigated the radial motions in this galaxy, and he finds a rotation period of 13 million years.

The Amateur Astronomer as a Community Teacher

By George W. Michalec

MANY of us find deep satisfaction in reading, studying, and digesting information about a favorite scientific field such as astronomy. Others enjoy doing original research and studying in their field of interest. Still others, unfortunately fewer, derive a particular kind of satisfaction and happiness in teaching people about their favorite science. This article is written in the hope of attracting amateurs of the first two groups into the third, and of helping those already in it.

The writer for years has been an ardent reader and student of astronomy. He has taught a course in general astronomy which has now been sponsored for two years in the Adult School of Pleasantville, N. Y. The experience described here may demonstrate to others the procedure for conducting similar courses in their communities.

With the large number of amateur astronomers in our country, it is probable that every sizable community has one or more, but only in the minority of places are there sufficient amateurs to form associations which carry out educational programs as part of their activities. Elsewhere, the individual amateur astronomer is in a position to acquaint the public with astronomy if he wishes to do so.

In the average community there are many, if not numerous, people who are mildly interested in astronomy or have at least a latent interest which needs only to be cultivated. Ample proof is demonstrated when public star parties, or the availability of a single amateur's telescope, are announced.

The teaching role of the amateur has a twofold purpose: for him to pass on to his neighbors his special knowledge; for him to have the fun of teaching, which will turn out not to be a burden or a chore. Besides, he will often find it is a paying activity, although the remuneration is small when the time and work are considered.

The first task is to contact those people of the community who are interested in astronomy, and to try to attract even those who are completely unfamiliar with the subject. The common methods of newspaper publicity and word of mouth are usually sufficient. However, many school administrators are eager to foster new educational programs, and a number of state educational systems now sponsor and finance local adult evening schools. These probably provide the amateur teacher with his best opportunity.

The writer is not familiar with the operation of adult schools in states other than New York. Here the state financially sponsors adult education just as it does the public schools. The local boards of education do the actual running of the school subject to state regulation. They decide what courses are to be given and who are to be the teachers. To teach in the adult school, it is necessary to obtain a teaching certificate from the New York State department of education. The requirements for this certificate are a college degree or enough special training to certify one to teach in a specialized subject. Certainly, amateur astronomers can at least meet the latter requirement. The procedure for obtaining the certificate is simple, especially since adult school administrators will usually assist in its procurement.

Not only will the adult schools sponsor and publicize astronomy courses, but they will solve the second problem of facilities, offering classroom space, with blackboards, equipment such as movie and slide projectors — and usually there is an adjacent large open playground which is wonderful for outdoor observing.

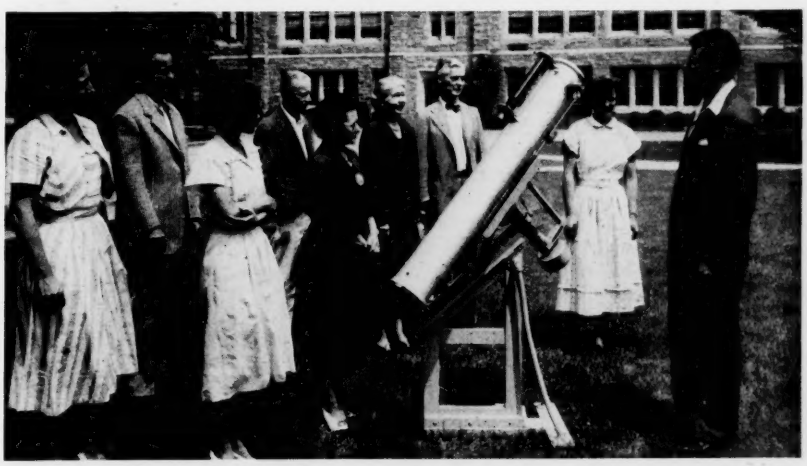
Younger people can also be approached through the school system. Science clubs in high schools and junior high schools are pleased to have an occasional guest speaker on an astronomical topic. The practical art and science departments may want to become sponsors for a telescope making class. The girl scouts and boy scouts are among community organizations that also can help reach young people.

Assuming that you have obtained the proper sponsorship and that the response has been successful, the big task of organizing the course lies immediately ahead. Do not wait for the last student to enroll before thinking about and planning the course! This phase should be started weeks in advance, for the amount of work is larger than appears from the surface and really is endless. Considerations for compiling the course involve the individual composition of the class, equipment and material available, and the amount of effort the instructor is willing and able to furnish.

Young teen-agers must be treated differently from adults. Ideally it is wiser, and it can be stated as a definite necessity for any course of even moderate length, to limit the class to one or the other group. Junior high and most senior high school students cannot comprehend and will have no interest in advanced mathematics, physics, and chemistry as applied to astronomy. The younger people are mainly fascinated by highly descriptive reviews of the more appealing topics, such as the moon and planets, how they would appear to a traveler, and the possibility for life to exist upon these worlds. Only as young students grasp the facts and show interest for more advanced work can it be attempted without jeopardizing their initial enthusiasm.

With an adult group the instructor has more opportunity for a varied course, depending entirely upon the students' academic backgrounds and their desires. Mature people usually have a better notion of what they want, but they may not know, and it is the responsibility of the instructor to know what they want and what they should be taught.

Except for the larger cities, it is rare to expect an enrollment of adults whose backgrounds have sufficient mathematics and science for an advanced course. More probably the class will be similar to those in the Adult School here in Pleasantville. These have included both



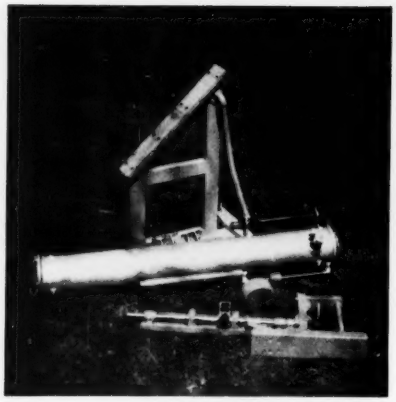
Part of the adult astronomy class at Pleasantville, N. Y., in outdoor session, with George W. Michalec, the instructor, at the right. Photo by Boyce Studio.

sexes in almost equal numbers. A minority were college graduates, and many had no previous mathematics, science, or astronomy. They included a cross-section of the community: housewives, local businessmen, engineers, school teachers, a physician, and several interested senior high school students. Such a mixture certainly had no academic common denominator except a keen desire to learn something about astronomy.

When confronted with such a heterogeneous group of students, maintain the course on a level that will interest all. This is not as difficult as it might seem. The level of the class should be set by the students with the least technical knowledge, within reasonable limits. The few very advanced students will unconsciously submit to a greater drop in level than the jump upward that least advanced students can undertake. This is probably partly due to our liking to believe that we know more than we do, and as long as we needn't admit it, it is quite satisfactory to take less advanced work with the excuse that it is for someone else's benefit. However, the instructor should not go overboard in this policy. The advanced students should be properly catered to, when appropriate subjects of discussion arise. It is certainly not asking too much of the less advanced student to sit back occasionally and become "lost" while the instructor goes off with some of the class for five minutes. There are often cases where the entire class can follow part of the way and they all receive a boost to a new level of interest. Incidentally, it is good for the instructor at least once to go just beyond his best student's ability, if possible, for it will give him self confidence and also assure his class of his own ability.

Many people, new to astronomy, imagine it to be entirely outdoor work and are surprised to learn it is an equally large and interesting indoor subject. The publicity pertaining to a course should state its nature. If one general course is offered, it should be a combination of indoor lectures and outdoor observing. More advanced intermediate and specialized classes should probably be entirely indoors. An exclusively outdoor observing course is fascinating and can have great drawing power for students. In most areas, however, the probability of having suitable observing weather on class nights is small. I find that good weather in the New York area on the same night of the week occurs on the average only about once in every three weeks. Therefore, it is well to run a combined course and to have the schedule flexible so advantage can be taken of clear evenings.

When astronomy is introduced as a new subject in an area, the course should be of a general nature. For the first year or two, this allows the instructor time to organize his presentation in a logical and convenient manner. While he gains valuable teaching experience, a general course will create a supply of students for later advanced courses.



The portable 6-inch reflector shown with the outdoor observing class on the preceding page is disassembled for easy transportation. Photo by Boyce Studio.

As for the length of class sessions, for adults it is advisable to limit meetings to 1½ to two hours. Going beyond that runs the risk of asking too much of the students, most of whom have already put in a hard day's work at their various occupations. The frequency of meeting is arbitrary, or perhaps it will be specified by the sponsoring institution. The usual once-a-week meeting is ideal, for adults have other interests which also require their attention.

If there is an observatory nearby, visits to it are very beneficial. But in most places the instructor's own instrument, 6-inch reflector, 3-inch or larger refractor, will serve well for observing needs. Ideally, such an instrument should be portable and capable of being set up in from five to 10 minutes. Essential for class work is a clock drive, or at least a manual slow motion. In addition, it is helpful to have at least one pair of binoculars or a small sighting scope to demonstrate the great sights that can be seen with such common optical instruments, and also to maintain interest among the observers while only one person at a time is looking through the main telescope.

For outdoor work a good constellation book and sky charts are essential. Some knowledge of constellation mythology is necessary, as students find this an interesting side study. For pointing out constellations and stars, the old technique of using a long narrow-beam flashlight is excellent.

When doing outdoor work in cold weather, the instructor should be considerate of the class. They all will not have his enthusiasm for heavenly sights on cold evenings, and observing should be limited to short sessions. Forewarn the class to dress properly for outdoor weather conditions. Better yet, arrange the class schedule so exclusively indoor work is done during the weeks of expected most adverse weather conditions.

In the concluding article next month, I shall give the course outline I have used at Pleasantville, and shall discuss supplementary teaching aids and the collection and preparation of material.

(To be concluded)

Amateur Astronomers

THIS MONTH'S MEETINGS

Dallas, Tex.: On Monday, September 25th, the Texas Astronomical Society will hold an eclipse party in Cole Park, corner of McKinney Ave. and Elizabeth St. Telescopes will be available and the public is invited. During the eclipse, the president, E. M. Brewer, will give the fourth and final talk on constellations for this year.

Detroit, Mich.: At the September 17th meeting of the Detroit Astronomical Society, Dr. E. Phelps, of Wayne University, will speak about the 200-inch telescope. The meeting will be held in State Hall, Wayne University, 2nd Avenue entrance, at 3:00 p.m.

Indianapolis, Ind.: William Garnatz will lecture on "Our Moon," at the meeting of the Indiana Astronomical Society on September 3rd in Garfield Park. On September 25th there will be eclipse observations at Link Observatory, Brooklyn, Ind.

Kalamazoo, Mich.: On September 9th the Kalamazoo Amateur Astronomical Association will hold a pot-luck supper at Wolf Lake. Robert Deller will speak on "Time"; Edgar Pashby, on "Rockets."

Madison, Wis.: The Madison Astronomical Society will hold an open house at Washburn Observatory on Wednesday, September 13th. Fall constellations will be described by Joanna Overn, Frank Grams, and Monroe Evans. There will be observing with the 15-inch telescope.

Washington, D. C.: The National Capital Astronomers will meet on Saturday, September 9th, 8:00 p.m. in the Commerce Building auditorium. The evening will be devoted to "Astronomical Group Dynamics," to find out what the members are interested in for future lectures, group discussions, and fields of practical astronomy projects.

NEW LEAGUE MEMBER

The Amateur Astronomers and Telescope Makers of Kansas City, Mo., were among the societies whose Astronomical League membership was approved by council action during the Wellesley convention. This society was inadvertently omitted from mention in the note on page 242 of the August issue of **Sky and Telescope.**

The Advertisements of J. A. Whipple

By Dorrit Hoffleit, *Harvard College Observatory*

WHILE HARVARD is celebrating the 100th anniversary of the first daguerreotype of a star, it is appropriate that something be said about the artist who, under the direction of the astronomers Bond, accomplished this feat. As described in the July issue, page 207, from 1849 through 1860 the Harvard Observatory record books make frequent mention of the volunteer services he rendered.

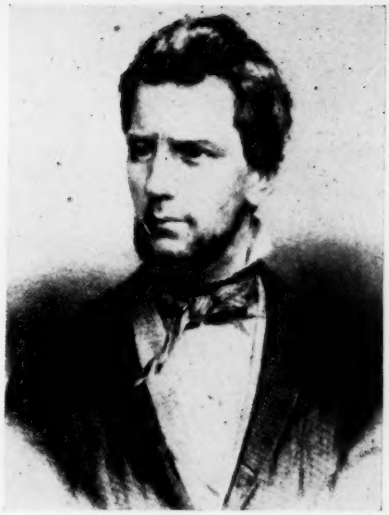
Appleton's *Encyclopaedia of American Biography*, 1889, tells that John A. Whipple, inventor, was born on September 10, 1822, at Grafton, Mass. As a boy he was an ardent student of chemistry. When the daguerreotype process was first introduced into this country, he was the first to manufacture the chemicals that were needed. Then, his health impaired through this work, he devoted his attention exclusively to photography, introducing many useful improvements.

Beaumont Newhall, in "The Daguerreotype" (*Antiques*, April 1948), notes the importance of Whipple's contributions by the comment, "Of all countries, America adopted the daguerreotype with most enthusiasm, and it lived longer here than elsewhere. Yankee ingenuity brought machinery into the galleries. John Adams Whipple, of Boston, installed a steam engine to run the buffing wheels, heat the mercury, fan the waiting clients in the reception room, and turn a gilded sunburst on his sign over the entrance to his gallery. At the Great Exhibition in the London Crystal Palace, 1851, America won three of the five medals awarded for daguerreotypes. 'The United States department is of a very superior character,' an English critic observed."

In addition to these brief items, one of which was written during Whipple's lifetime, and the astronomical references to his work at the observatory, I have been able to find little more about Whipple in the books that are readily available here. However, James L. Bruce, of the Bostonian Society, suggested that some facts about Whipple might be gleaned from the *Boston Directory*. What follows in this article is based on that publication. Whipple's name is listed in the volumes for the years 1843 through 1891, the first time as a chemist. His initial appearance in an advertisement in the directory is for the year 1846-47 under "Litch and Whipple," which states, "They take the largest Portraits in the United States THE SIZE OF LIFE Groups two to fifty on a single plate." However, an excellent group photograph of the Massachusetts Historical Society taken in May, 1855 (*Proceedings*, Volume II), shows 26 men, which was claimed to be the largest group ever photographed by Whipple.

In the directory for 1847-48, a one-inch note announces that John A. Whipple "Has taken the old stand formerly occupied by Litch and Whipple, No 96 Washington Street, where he will give personal attention to all who will be pleased to give him their patronage...." The following year he reported engineering progress, "After much patient experimenting I have finally succeeded in applying, with more uniform results and certainty, Steam power to all the mechanical parts of Daguerreotyping and consequently am enabled to furnish my customers Better Miniatures in less time." This new process he claimed enabled him "to make family groups on the largest plates as perfect as the ordinary sizes." The 1849-50 directory adds, "He has just secured Letters Patent for a process for making Daguerreotypes in the style of crayon drawings, thereby entirely removing the set and stiff look to which the usual Daguerreotype is liable."

Thus Whipple's reputation as an accomplished and experimental daguerreotypist was already well established when the Bonds encouraged him to try celestial targets. His first success with the moon came on December 18, 1849, and the first star picture he took on the night of July 16-17, 1850. In his 1851 annual advertisement in the *Boston Directory*, he placed the importance of his astronomical achievements on a par with his probably more remunerative and spectacular successes in having had Jenny Lind and the Turkish ambassador as sitters.



John Adams Whipple, from a lithograph by Francois d'Avignon, originally published in the "Photographic Art Journal," August, 1851.

The achievements of his 10 years' scientific and artistic efforts in his trade had won him recognition and "The Highest Premium" at the 1850 Mechanics Fair in New York. Meanwhile, keeping his studio in Boston, he had changed his residence to Cambridge by 1852, thereby making it more convenient for him to experiment in celestial photography at the observatory.

In 1852 he announced further progress in his technique: "New Discovery. Daguerreotypes taken on Paper instead of Silver Plates with all the beauty and distinctness of engravings. J. A. Whipple, Patentee... Is prepared to exhibit his new style of Daguerreotype on Paper, called the CHRYSTALOTYPE, which is admitted by all to be far superior to the ordinary Daguerreotype. He was awarded a Prize Medal at the World's Fair, and the highest Premium at the last Fair of the Mechanics' Charitable Association."

James Wallace Black, who figured with Whipple in numerous Harvard Observatory records in 1857, appears to have been associated with Whipple from 1852 through 1859, the last three years as a partner. The 1859 advertisement of the "Whipple and Black Daguerreotype and Photograph Establishment," at Whipple's usual address, 96 Washington Street, tells us a bit about the reactions of the photographic materials to different colors: "Red, Green, and Yellow are always represented as Black

WHIPPLE'S

EXTENSIVE DAGUERREOTYPE ESTABLISHMENT,

No. 96 Washington Street, Boston.

THE MECHANICAL PART DONE BY STEAM.

He received the HIGHEST PREMIUM at the last Mechanics' Fair; has every facility for producing the very best Daguerreotypes, and ten years experience in the art. All Likenesses warranted perfectly satisfactory to friends, if not so at the first trial, repeated without charge, it being his aim not only to produce the best thing the art is capable of, but pleasing likenesses to those for whom they are intended. The public are invited to call and examine a large collection of Daguerreotypes of some of our MOST DISTINGUISHED CITIZENS; also, those of JENNY LIND, Benedict, Belletti, Barnum, Amin Bey, the Turkish Ambassador, and THE MOON, taken through the large Cambridge Telescope; Microscopic objects, too small to be seen by the naked eye, &c. &c.

Astro-daguerreotypist Whipple's advertisement in the 1851 "Boston Directory."

in the Photograph; Blue and Pink as White or Drab."

In 1860, Whipple no longer listed Black as his partner, but announced that he, himself, was continuing practice at his old stand, "He has had 20 years experience and is assisted by the best artists to be obtained in the country," while Black was associated with another partner, Batchelder. Thereafter Whipple's advertisements on photography continue intermittently through 1873.

It is of interest to note that the business directory through 1877 classified men in this type of work as *photographists,* which in 1878 was changed to the term *photographers.*

By 1865, Whipple had moved to 297 Washington Street, on the corner of Temple Place. In 1870 he added "Porcelains" to his photographic activities.

After the exuberance in his achievements evident in his early advertisements, it is disappointing not to find any notice whatever in 1870 of his contributions to the success of the first Harvard eclipse expedition utilizing photography, to Shelbyville, Ky., in 1869. Under Professor Winlock's direction, 80 photographs of the eclipse had been taken, seven of them during totality. In this work Winlock had been assisted by Whipple, George D. Clark, John Pendergast, and a Mr. Williams, a local photographer.

Whipple is listed for the last time as a "porcelain and photograph artist" in the 1873 directory. The following year his business address had changed to 36 Temple Place, but no occupation was given for him until 1879, when he was recorded as a bookseller. He is listed in this capacity through 1891, first at 36 Temple Place, then at 3 Hamilton Place, 120 Tremont Street, and finally at 40 State Street.

From a sequence of names occurring between 1878 and 1883, one infers that Whipple had a son who assisted him in those years. In 1878 and 1879, below Whipple's name there is another, "Whipple John A. jr clerk" also at 36 Temple Place who "boards at Cambridge," whereas, for the photographer it said "house in Cambridge." The next year, 1880, the presumably younger man's name is given (with the same supplementary information) as "J. Adams Whipple, clerk," and in 1882, when both Whipples had moved to 3 Hamilton Place, simply as Adams Whipple. After 1883 he is no longer mentioned.

BOUND VOLUMES

We are closing out our stock of bound volumes at the cost price of $5.50 per volume postpaid. Only Volumes IV, V, and VI are available. These are for the years 1944-45, 1945-46, and 1946-47, respectively. Please remit with your order.

SKY PUBLISHING CORPORATION
Harvard Observatory, Cambridge 38, Mass.

TERMINOLOGY TALKS

J. Hugh Pruett

Syzygy

Last month we discussed the meaning of conjunction and opposition, especially the relation of the moon or a planet to the sun. Here we explain a term which applies to both conjunctions and oppositions. *Syzygy* (sound all *y*'s as *i* in pin, *g* as *j,* and accent the first syllable) indicates that the three heavenly bodies concerned are practically in a straight line. Syzygy occurs at both new and full moons, with the sun, earth, and moon lined up. However, only rarely is the line really straight. The moon's orbit is inclined about five degrees to the plane of the ecliptic, so only when the moon is new or full at one of the nodes (the crossing points of its orbit with the ecliptic) is nearly perfect syzygy obtained. Then there is a central eclipse of either the sun or the moon, depending upon whether the moon is in conjunction or opposition with the sun.

Superior and Inferior Conjunctions

The inner planets, Mercury and Venus, circle the sun on orbits inside that of the earth. Thus they may be at the same longitude as the sun — and so in conjunction with it — under two quite different conditions. Each may pass almost between us and Old Sol and undergo what is known as an *inferior conjunction.* Or the inner planet may be lined up with the sun and earth by being beyond the sun, a condition known as *superior conjunction.* Since Mercury and Venus cannot appear to us in the opposite direction from the sun; they are never in opposition. On the other hand, all of the other planets do undergo opposition, but they never can have inferior conjunctions as their orbits lie outside the earth's.

Elongation and Quadrature

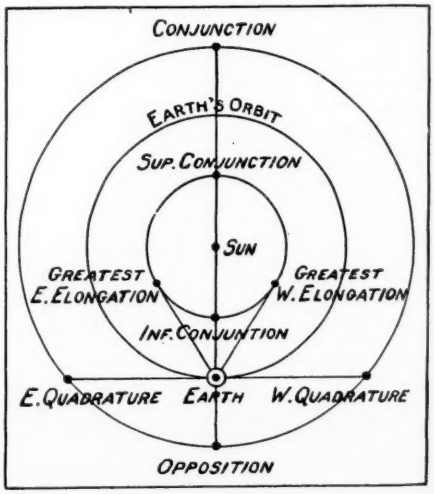
The angular distance of the moon or a planet from the sun is known as the *elongation.* It is near 0° at conjunction; near 180° at opposition, and when it is 90° the body is said to be in *quadrature.* It is western quadrature if the body is west of the sun, and eastern quadrature if the body is east of the sun. In the first case, the planet would rise roughly at midnight and be near the meridian at sunrise; in the second case, the planet would be near the meridian about sunset.

The inner planets have a term, however, which applies only to them. It is *greatest elongation* (east or west), and is represented by various angles, but never more than 28° for Mercury and 48° for Venus. The 28° and 48° are the greatest possible greatest elongations. On the other hand, Mercury may have a greatest elongation of as little as about 18° from the sun.

Configurations of a Planet

As the term *aspect* is in prevalent use among astrologers in reference to planetary conjunctions, elongations, and the like, it is preferable to employ the term *configuration* to describe a planet's changes in position with reference to the sun and other bodies. In succession, Mercury or Venus passes between us and the sun at inferior conjunction and into the morning sky, where greatest elongation west is attained; then the planet overtakes the sun and passes beyond it at superior conjunction, and into the evening sky; there greatest elongation east occurs, and this is followed by a merging of the planet with the sun again at inferior conjunction.

Mars, Jupiter, and the other outer planets are far beyond the sun at conjunction, when they pass into the morning sky. Many months later they reach western quadrature, and after many more months, opposition. While at opposition they are in *retrograde motion,* a term we shall discuss next month. Next they reach eastern quadrature, well placed for early evening observation. Finally, they merge with the sun again, once more at conjunction. Generally speaking, a superior planet is nearest to the earth and appears brightest when it is near opposition — Mars may be only 35 million miles away at a very favorable opposition, yet nearly 250 million miles away at certain conjunctions. Note that as a result of the earth's faster motion, a superior planet appears to be overtaken by the sun.



The major configurations of the planets are indicated by points on this diagram. An inferior planet, shown by the orbit inside the earth's, has phases like the moon, full at superior conjunction and dark or "new" at inferior conjunction, and is best observed near greatest elongation. A superior planet, shown by the outer orbit, is best observed when near opposition to the sun.

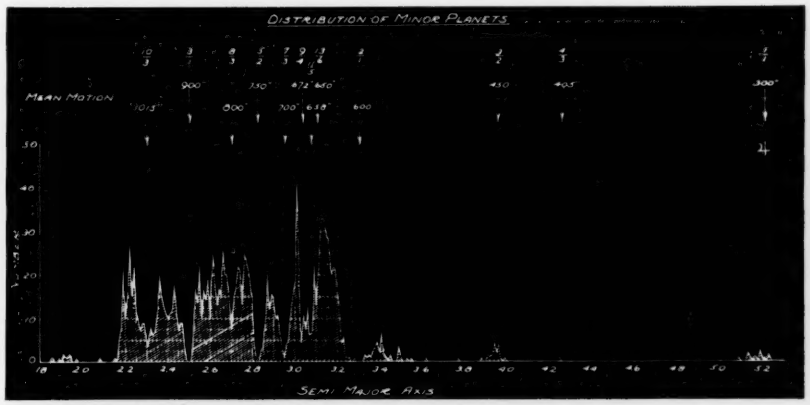
AMERICAN ASTRONOMERS REPORT

Here are highlights of some papers presented at the 83rd meeting of the American Astronomical Society at Bloomington, Indiana, in June. Complete abstracts will appear in the Astronomical Journal.

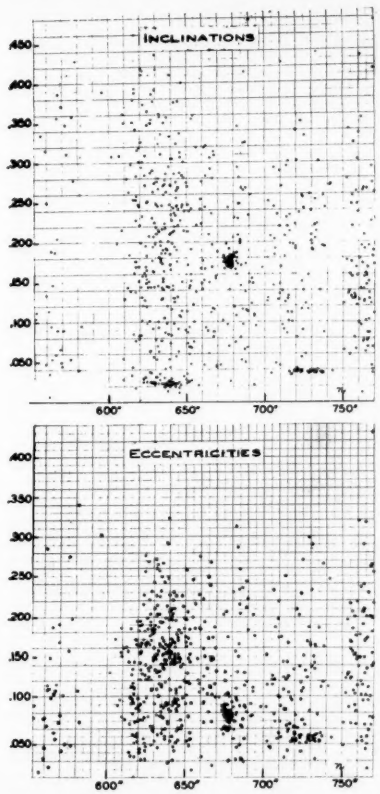
Minor Planet Symposium

IN 1868, Daniel Kirkwood, professor of mathematics at Indiana University, where the symposium on minor planets was held, discovered certain gaps in the orbits of the asteroids that are attributed to the perturbing action of Jupiter. At that time 100 minor planets had been discovered, and Kirkwood used 97 in his tabulation. As shown by the accompanying graphical representation of asteroids with numbered orbits listed in the minor planet ephemeris for 1947, Kirkwood's discovery has been abundantly confirmed.

The notion that the minor planets are fragments of a larger body originated with Olbers, who discovered Pallas and Vesta early in the 19th century. The mere fact that two planets have similar orbits does not give much useful information concerning their long past histories. The attractions by the principal planets change the orbital elements continually, and two asteroid orbits that now nearly intersect may not have done so thousands or millions of years ago. Dr. Dirk Brouwer, director of Yale University Observatory, the first symposium speaker, pointed out that it is necessary to examine the "proper" elements, that is, those freed from the slowly varying effects of planetary perturbations.



The distribution of the asteroids according to mean distance from the sun, for 1,563 minor planets listed in the ephemeris volume for 1947. Note Kirkwood's gaps — the avoidance of periods that are certain fractions of Jupiter's period of 11.86 years; also, the Trojan group that has the same period as Jupiter. Diagrams on this page are from Yale University Observatory.



For asteroids with mean daily motions of from 550 to 770 seconds of arc, the proper inclinations and proper eccentricities are plotted here. Three families recognized by Hirayama are distinctly shown, named Themis, with 47 members; Eos, 58 members; Coronis, 33 members. Their mean motions, average inclinations, and average eccentricities are, respectively: 625-652, 0.02, 0.15; 673-683, 0.18, 0.08; 716-744, 0.04, 0 05. In other parts of the asteroid r.ng, Hirayama found three more similar families.

Families of minor planets were established in this manner by K. Hirayama in a series of papers beginning in 1917. In his final paper, in 1933, he used 1,223 orbits, 192 of which were found to belong to five principal families, the largest known as the Flora family. With his theory, it is possible to define two constants, the proper eccentricity and the proper inclination. The longitude of the proper perihelion advances uniformly and the longitude of the proper node regresses uniformly, in fact, the sum of these should have a very slow motion as they are nearly equal in amount.

Recently, a new calculation of the secular variations of the principal planets was made at Yale by Dr. Brouwer and Dr. A. J. J. van Woerkom. A considerable number of new family members may be added, especially to the Flora family, raising its total to 119. Eleven per cent of the 340 asteroids discovered since 1933 belong to the Flora family. Several additional families could be added to Hirayama's groups.

From the scatter among the proper elements it is possible to draw some conclusions as to the average velocities with which the fragments were dispersed when the parent body broke up. The required velocities are quite small, only about 300 feet per second for the more compact families, and about 1,000 feet per second for the Flora family. There is some indication that certain families may be younger than others, but the question of the age of the ring of minor planets is still unanswered, Dr. Brouwer stated.

In discussing the origin of asteroids, Dr. Gerard P. Kuiper, of Yerkes and McDonald Observatories, pointed out that Olbers' theory of planetary breakup, with appropriate modifications, is far more probable today than a century ago. At present, some 1,600 asteroids have known orbits, and at least 30,000 are within reach of the large reflectors; the asteroids, with a few exceptions, appear to have broken surfaces; the genetic relation between meteorites and asteroids has become increasingly clear.

Four possible mechanisms could account for the parent planet's breakup: an explosion, rapid rotation, tidal breakup, and collision. Dr. Kuiper ruled out all of these except collision between two small planets. From his studies of the origin of the solar system, he believes there may have been from five to 10 original small planets in the region between two and 3½ astronomical units from the sun. Some of the largest asteroids observed today, such as Ceres, may be regarded as original condensations, and as such are in effect true planets.

The probability that any two of these small planets collided in the past three billion years is about 0.1 if the orbital

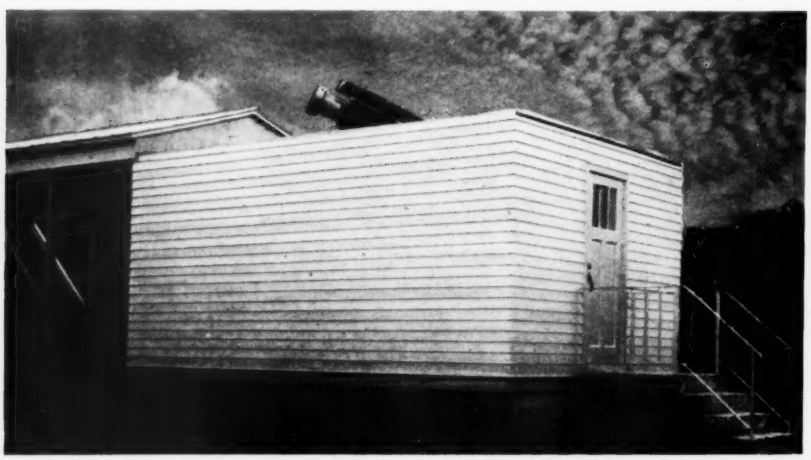
inclinations were less than five degrees and the eccentricities about 0.1. The average relative velocity at collision was then about one kilometer per second. Somewhat different figures may be obtained by small changes in the initial assumptions. Once a single collision occurred, secondary collisions would become vastly more frequent. Dr. Kuiper is seeking further to determine which observed asteroids are fragments and which are true original planetary condensations. Hirayama's families may be regarded as due to relatively recent secondary collisions, while the remaining five sixths of the asteroids may have formed during earlier collisions.

The hypothesis that meteorites are but the smallest asteroids has emerged, for example, from the work of C. C. Wylie, who has shown that meteorites generally arrive in direct orbits of asteroidal properties. The sizes of meteorites striking the earth, on the average somewhat less than 10 centimeters, are in accordance with their origin in the asteroid ring about three billion years ago and subsequent spiraling inward toward the sun under the Poynting-Robertson effect. The existence in meteorites of silicates immerged in iron and solid iron drops in silicates proves that the parent body had a small gravitational field; the iron must have been molten and later solidified while cooling extremely slowly, as evidenced by the Widmanstaetten figures. All these facts are consistent with the collisional origin of the asteroid fragments.

At present the Minor Planet Center of the International Astronomical Union is at the Cincinnati University Observatory, under the direction of Dr. Paul Herget, who outlined current problems in keeping track of these elusive objects. The burden of the tremendous number of minor planets which are known to exist is not helped by the fact that the work of taking and reducing asteroid plates is essentially the same as it was a half century ago — there is no prospect of improvement in observing methods by any large factor.

The effect of wartime interruption to observations and computations has not been overcome; many recently numbered planets suffer from misidentification or wrong positions; elements of some asteroids were not properly improved 10 or 15 years ago, when they might have been. The number of asteroid observers is very small, and their equipment is limited, but some observatories have adopted the practice of checking their wide-angle plates, such as those taken with the 20-inch camera at Lick Observatory, for objects with unusual motions.

Recently, the availability of large-scale computing facilities has had an important influence, particularly in providing more reliable predictions of an asteroid's future positions. Two large programs of approximate perturbation computations for 149 asteroids have been completed at the Cincinnati Observatory. Additional work is under way on improving the actual methods of computation. A large number of recent asteroid identifications has reduced the uncertainty in the orbits of many of them, and several important recoveries of "lost" asteroids have been made with the search camera at the Goethe Link Observatory, pictured here. Dr. H. M. Jeffers, of Lick Observatory, has attempted to follow known asteroids as close to the sun in the western sky as possible, thus reducing the uncertainty in their recovery in the morning sky.



The asteroid-hunting 10-inch Cooke triplet camera, which has recovered a number of important asteroids, is housed in this new building at the Goethe Link Observatory, University of Indiana, on loan from the Cincinnati University Observatory. The Goethe Link Observatory is at Brooklyn, Ind.

Interstellar Gas in Galaxies

SPECTRA of 50 galaxies on red-sensitive film, taken this spring by Dr. Thornton Page, Yerkes and McDonald Observatories, with the 82-inch McDonald reflector, show hydrogen-alpha emission in 27 cases. It is believed that very hot stars in these galaxies emit invisible ultraviolet light which causes the interstellar gas, consisting of hydrogen, oxygen, nitrogen, neon, and other common elements, to shine with characteristic visible wave lengths, as in the case of the hydrogen-alpha line.

Dr. Page also finds fainter emission lines in some of these spectra for these other elements as well as hydrogen, and by two independent methods is able to estimate the temperatures of the hot stars emitting the exciting ultraviolet radiation as being from 13,000° to 25,000° absolute, corresponding to early *A*- and *B*-type stars. He pointed out that galaxies showing no emission lines must be practically devoid of early-type stars, or of interstellar hydrogen, or of both. If the galaxies have actually two kinds of stellar population, his method of observing their spectra should aid in classifying them.

Martian Geology

THE ruddy color of Mars may be due to naturally red rhyolitic igneous rock on desert surfaces. The dry climate and thin atmosphere, coupled with a lower temperature, would retard any chemical action on the surface, according to Clyde W. Tombaugh, of White Sands Proving Ground.

The distribution of the maria and desert areas conforms well with the tetrahedral shape produced as a globe shrinks in volume after a thick crust has already formed. Mr. Tombaugh suggested a similarity of Mars to the earth in this respect. Three of the corners would correspond to the major desert areas, while the eccentric position of the south polar cap suggests that the fourth vertex would fall there.

The round oases found on Mars could be impact craters caused by collisions with small asteroids. The radial pattern of canals can be attributed to fracturing of the thick crust under the strain of impact. Great dust clouds observed on Mars occasionally indicate that some wind erosion, if extended over long geologic ages, might mitigate the abrupt slopes of the craters. The dark color and seasonal behavior should undoubtedly be due to a low form of vegetation which finds favorable environment in the pulverized igneous rock and shelter in the craters and fractures.

Stern geological consideration of the planet's natural resources is highly unfavorable to the economics required for an intelligent civilization on Mars. Nevertheless, Mr. Tombaugh added, the canals cannot be entirely relegated to the realm of illusions, in spite of the unfortunate misrepresentation given by the drawings of some observers or of the doubts of those who do not know how to observe fine planetary detail.

NEWS NOTES

By Dorrit Hoffleit

NEWTON L. PIERCE DIES

On August 8th, after a brief illness, Dr. Newton L. Pierce died in a hospital in Philadelphia. Particularly well known for his work on eclipsing stars, he was associate professor of astronomy at Princeton University and assistant director of Princeton Observatory. Forty-five years old at the time of his death, Dr. Pierce had taken his bachelor and master of science degrees at the University of Michigan, and received his doctorate from Princeton in 1937.

Professor Pierce was co-author with Dr. John Q. Stewart of the book, *Marine and Air Navigation,* a text published in 1944, widely used in the teaching of navigation.

HUGE CRATER POSSIBLY OF METEORITIC ORIGIN

Located in the northern wilds of Quebec, near 63° north latitude, 73° west longitude, is a crater 2½ miles wide that may have been caused by the crash to earth of a meteorite some 3,000 to 5,000 years ago. This is the estimate of Dr. V. Ben Meen, director of the Royal Ontario Museum of Geology and Mineralogy, who late in July flew to the site of the crater with an expedition sponsored by the University of Toronto and the Toronto *Globe and Mail.*

According to press accounts, the crater was discovered by a prospector, Fred W. Chubb, who noticed on aerial photographs the ice-covered round lake that has formed in the crater. The highest portion of the crater wall, composed of fragmented granite, is estimated at 550 feet above the level of the surrounding land, and the water surface is 80 feet above the level of lakes in the vicinity. No meteoritic fragments have been found. A new expedition to carry out a thorough examination of Chubb Crater is expected to report to the Canadian government within a year.

SCIENCE EXHIBIT TO TOUR LATIN AMERICA

Late in August a UNESCO traveling exhibit was scheduled to open at Lima, Peru. It was designed and constructed at Massachusetts Institute of Technology under the direction of Mrs. Christina Buechner, executive secretary of the National Research Council's committee on international scientific publications.

A Spitz planetarium, to be set up in a portable dome seating about 50 people, features the astronomical portion of the exhibit. A Van de Graaff electrostatic generator demonstrates high-voltage effects. Science Clubs of America, high school groups sponsored by Science Service, have contributed exhibits on wind tunnels, bird banding, homemade telescopes, and rainfall measurements.

IRISH ASTRONOMICAL JOURNAL AND CLOUDS ON MARS

March, 1950, saw the publication of the first number of the quarterly *Irish Astronomical Journal,* official organ of the Irish Astronomical Society, which was founded on October 18, 1946. The society has centers at Armagh, Belfast, Dublin, and Londonderry. The editor of the new publication is Dr. E. J. Opik, of Armagh Observatory (formerly of Estonia). Unpublished work of his, "Collision Probabilities with the Planets and the Distribution of Interplanetary Matter," leads him to speculate in an article in the new journal, upon the cause of the huge gray cloud observed on Mars by a Japanese observer on January 16, 1950.

In view of the lack of evidence of older volcanoes on the planet, Dr. Opik rejects a volcanic explanation for the cloud and proposes that a body of 50 to 100 meters diameter striking Mars at from 10 to 15 kilometers per second would produce an effect far exceeding the atomic bomb in intensity.

From 10 to 20 per cent of the asteroids in the vicinity of Mars should have survived the 3,000 million years age of the solar system. Twenty-seven asteroids are known to cross the orbit of Mars, two thirds of them being larger than 10 kilometers in diameter. Allowing for many smaller undiscovered bodies, Dr. Opik finds that a body of 10 kilometers or larger should collide with Mars on an average of once every 100 million years; a body with a one-kilometer dimension might collide every 100,000 years, and one of 1/10 kilometer every 100 years. The last corresponds to the estimated size of the mass that produced Meteor Crater in Arizona.

Erosion on the ruddy planet, where atmosphere and water are much scarcer than on earth, would permit the present existence of craters formed as long as 10 million years ago. Thus, Dr. Opik suggests that hundreds of thousands of craters exceeding Meteor Crater in size should still pockmark Mars. (Clyde Tombaugh recently discussed a similar possibility, see page 272.)

HAYDEN PLANETARIUM COURSES

Starting in September and again in January, the Hayden Planetarium will offer a series of six courses, each to meet once a week in informal lecture sessions for the term. The subjects covered in the various courses include modern celestial navigation, applied navigation, descriptive astronomy for teachers, astronomy without mathematics, young people's astronomy, and star identification. Further information may be had from the Hayden Planetarium, 81st St. and Central Park West, New York 24, N. Y.

JOHN C. DUNCAN GOES TO ARIZONA

On June 30th, Dr. John C. Duncan retired as professor of astronomy at Wellesley College and director of Whitin Observatory, after holding that position for 34 years. In the academic year 1950-51, he will be visiting professor of astronomy at the University of Arizona and visiting astronomer at Steward Observatory.

OPTICAL SOCIETY MEETING

The Optical Society of America will hold its 35th annual meeting at the Hotel Statler, Cleveland, October 26-28. In addition to papers on all phases of optics, there will be a special program of invited papers on crystals. A session on lighting and seeing, together with a tour of the Lighting Institute of the General Electric Company at Nela Park, is scheduled for the afternoon of the 27th. All interested persons are invited to attend the meeting.

In the CURRENT JOURNALS

A SURVEY OF GEOPHYSICS, by Friedrich Gassmann, **Scientific Monthly,** June, 1950. "The planet on which we live is one of the most interesting and beautiful subjects of research in applied physics."

NEUTRONS AS WAVES AND PARTICLES, by E. O. Wollan and C. G. Shull, **Physics Today,** July, 1950. "Indifferent to the charge of a nucleus or its electrons, neutrons can penetrate where charged particles can not. Their use to probe the structure of matter is opening up the promising new field of neutron diffraction."

FINAL ADJUSTMENTS AND TESTS OF THE HALE TELESCOPE, by I. S. Bowen, **Publications** of the Astronomical Society of the Pacific, June, 1950. "Since the inception of the 200-inch-telescope project it has been realized that the key to the success of the telescope lies in maintaining the exact optical shape of a mirror of this size in all orientations and often with rapidly changing temperatures."

THE INDEX TO VOLUME VIII

of Sky and Telescope is now on sale. This and the indexes to previous volumes cost 35 cents each, in coin or stamps, or included in the payment of the renewal of your subscription.

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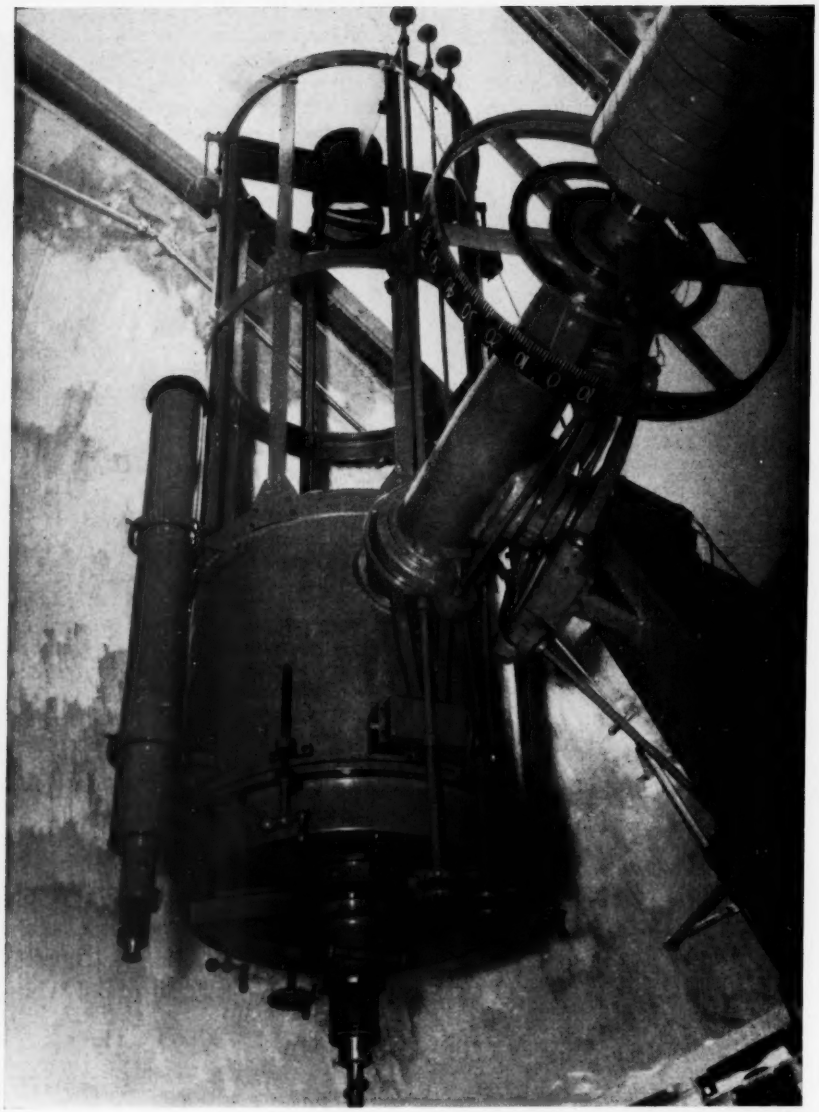
Astronomy at Agnes Scott

By William A. Calder
Bradley Observatory
Agnes Scott College



The 30-inch reflecting telescope of the Bradley Observatory.

DEDICATION of Bradley Observatory of Agnes Scott College, Decatur, Ga., took place on June 3, 1950 (see the front cover). This is the first adequate observatory in an important area of the Southeast. Hundreds of students and visitors will have their lives enriched because of the vision and prodigious effort of Dr. James R. McCain, president of the college.

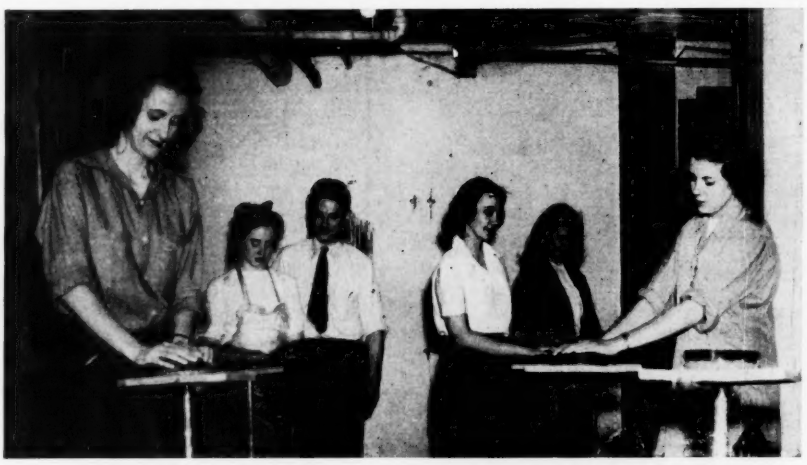
At the foot of the telescope pier, in the main lobby where one enters the building, is a plaque giving the geographical co-ordinates of the pier as determined by the U. S. Coast and Geodetic Survey. The surrounding walls have spaces for photographs and transparencies being given by members of the Atlanta Astronomers, our local amateur society that has Bradley Observatory as its headquarters.

To the left of the rotunda is a lecture room with a seating capacity of 125 persons. There is a small stage which, by a strange coincidence, is ideal for chamber music. The first floor also has a large room for telescope making activities, a darkroom, library, and offices. One of the most attractive features is the 14-foot planetarium dome — far superior to the parachute under which the author has had formerly to stack school children of the region. The planetarium projector is the same as that described in *Sky and Telescope,* VIII, 181, 1949. It is of the pinpoint projection type, with separate optical projectors for the planets. A gift of $1,000 toward the planetarium chamber was made by Mandle Zaban, of Atlanta.

There is a large flat roof for constellation study, where portable instruments can also be set up. These can be stored in a room beneath the telescope. Ample space for laboratory work is provided in the basement of the building.

The largest contribution to the project was a gift of $50,000 made by the W. C. and Sarah H. Bradley Foundation, of Columbus, Ga. The Aluminum Company of America donated the ¼-inch aluminum plate and structural elements for the dome; this, in turn, was fabricated largely as a gift by the R. D. Cole Manufacturing Company, of Newnan, Ga.

Our principal instrument is a 30-inch



Agnes Scott College students who make telescope mirrors in connection with courses in optics and astronomy receive a quarter hour of laboratory credit. Photos by Dorothy E. Calder.

reflecting telescope, formerly owned by Henry C. Gibson, Jenkintown, Pa. It has a Warner and Swasey mounting, with optical elements by J. W. Fecker, and was completely refurbished and modified to suit our Dixie latitude by the Perkin-Elmer Corporation. It is now known as the Lewis H. Beck telescope, as $15,000 was contributed for it by the Beck Foundation, of Atlanta.

The Research Corporation of New York has contributed $3,100 for a photoelectric photometer, being made by the John F. Jewett Company, Amherst, Mass., and a two-prism slit spectrograph, by Perkin-Elmer.

The new observatory climaxes quite a "skyslide" we have had at Agnes Scott College. The number of students in astronomy has trebled for three successive years until the astronomy enrollment comprised a fifth of the total student body. Astronomy courses at Agnes Scott are being made available for credit to students of Emory University and Georgia Institute of Technology.

Classes in telescope making have also been conducted for the past three years, and amateur astronomers have developed optical shop activities. The Atlanta Astronomers have been active also in conducting lecture meetings and in the publication of a journal, *Atlanta Astronomers Report*. Every effort has been made to encourage attendance at the planetarium by school groups.

FILMING A SKY SPECTACLE

By Peter A. Leavens

VIRTUALLY all the Western Hemisphere will watch a total eclipse of the moon on Monday evening, September 25th. Lunar eclipses occur when the moon, in its revolution around the earth, moves through the great conical shadow cast out into space by our world. When we see our satellite traverse the curved edge of this dark circle, we are witnessing one of the several proofs that the earth is a sphere.

Besides being interesting to watch, this eclipse makes an excellent out-of-the-ordinary event for amateur photographers to record, both in still pictures and movies. As with most terrestrial subjects, exact exposure is the paramount criterion. The majority of filmers tend to give much longer shutter time than is necessary when they shoot the moon, failing to remember that it, too, is sunlit.

Every shadow cast by an object where the light source has an appreciable size has a *penumbra,* or outer shadow, and an *umbra,* or full shadow. An imaginary observer on the moon when it is passing through the penumbra would see the earth partially eclipsing the sun; and if in the umbra, he would view a total solar eclipse by the earth.

There is subtle coloring during the penumbral phases of a lunar eclipse, and even while the moon is completely immersed in the umbra, refraction of sunlight by the atmosphere renders the moon visible with a ruddy glow. Ansco Color, Kodachrome, and Ektachrome will record these hues if accurate exposures are used for the various stages. The requirements in this article were compiled from several years of testing with modern emulsions.

A prerequisite of most celestial work with regular camera equipment is some sort of telephoto lens. Although individual images satisfactory for limited enlargement can be obtained with still cameras using 120 roll film (2¼ x 2¼ inches) or larger, smaller equipment requires supplementary lenses. It follows that all motion picture cameras must be stepped up in magnification. For 16-millimeter at least a 4-inch telephoto lens is desirable, and preferably one of six inches focal length; for 8-millimeter, these figures may be halved.

In taking stills, the most effective scenes are made where some prominent tower, building, or other illuminated structure forms the foreground of a *series* shot. This consists of a succession of moons on the same black-and-white negative or color positive: an exposure is taken exactly every five minutes, showing either the first or last half of the eclipse. The camera is not moved because the earth's rotation takes care of repositioning the moon between exposures so they will not overlap, forming a smooth sequence across the scene. This type of sky spectacle picture obviates the specific need of telephoto on small cameras. West Coast observers of the coming event can also include that section of the eastern horizon over which the moon will rise at twilight, already partially obscured by the penumbra.

For movies, the stop-motion (lapse-time) technique is always good. Here the cinematographer exposes a frame each second over, say, six minutes, so that when the film is screened the actual motion of the eclipse becomes discernible. Because of the earth's rotation, it is important to start such coverage with the moon placed at one side or the bottom of the finder; then it will travel across the field of view in the period photographed.

For average camera focal lengths, exposures of more than 1½ or two seconds should never be attempted unless an equatorial mounting with clock drive is available to counteract the motion of the sky. Times given in the accompanying exposure tables are Eastern standard, p.m., for the first half of the eclipse, and apertures for any intermediate stage may be easily interpolated. *Clear* skies are assumed, and allowance must be made for noticeable haze or dimming by thin clouds.

STILL PICTURES

Ansco Supreme or Eastman Plus X, black and white

9:28 deep in penumbra	f/11	1/50 sec.
9:51 ¼ in umbra	f/8	1/25
10:12 ½ immersed	f/7.7	1/10
10:33 ¾ immersed	f/6.3	1/5
10:51 almost total	f/5.0	1/2
10:58 in totality	f/4.0	1

Daylight Ansco Color, Ektachrome, or Kodachrome

Deep in penumbra	f/9	1/10 sec.
Shadow "bite"	f/7.5	1/10
½ immersed	f/6.3	1/5
Deep in umbra	f/4.5	1/2
Just before totality "Japanese lantern"	f/2.0	1/2
Totality	f/1.4	1/2 & 1

MOTION PICTURES

Kodachrome or Ansco Color

Well in penumbra: 1/30 second continuous operation, at f/5.6

Stop-motion, rated 1/25 second frame exposure:

1/5 shadow (about 9:45)	f/4.5
½ immersed	f/3.0
¾ immersed	f/2.2
Very deep in umbra	f/1.4

Eastman Super X or Ansco Hypan, black and white

1/30 second continuous operation:

¼ in shadow	f/8
½ in shadow	f/5.6
¾ in shadow	f/4.0

Ansco Triple S Pan or Eastman Super XX

Stop-motion, 1/25 second shutter, starting at 10:50 p.m. to show moon going into totality and outer umbra — f/2.0 to f/1.4

Of course, many amateurs have their telescopes equipped to take celestial photographs, and these tables may be applied in those cases where the entire instrument can be treated as a camera, that is, for pictures taken in the focal plane. Where eyepiece projection is used, or camera equipment has been attached to the telescope, modification of these exposure times must be made.

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BOOKS AND THE SKY

MEASURING OUR UNIVERSE

Oliver Justin Lee. The Ronald Press Company, New York, 1950. 170 pages. $3.00.

THIS is one of the books in a series entitled Humanizing Science. Written in a leisurely fashion for the layman, with time out for poetic thoughts now and then, **Measuring Our Universe** makes a pleasant supplement to the library of the amateur. Since the book is limited in the phases of astronomy it covers, as the title indicates, it should not be the first or only book of astronomy for the beginner.

The scale of the universe is an extremely important consideration, and many other problems and properties of the universe are dependent on its dimensions. The reader is informed of various experiments which lead to the determination of the velocity of light. The author discusses at some length the measuring machines used in determining very accurately the distances between stellar images on a photographic plate or the relative positions of spectral lines on a spectrogram. Since the measuring machine plays a crucial role in the distance determination by the trigonometric parallax method, it is gratifying to see that this aspect is adequately emphasized. Dr. Lee could have expatiated somewhat more on the straightforward trigonometric method for distance determinations; though it is applicable for only a very small portion of the universe around us, it provides the groundwork for indirect methods which the astronomer has ingeniously contrived.

The author describes the principal indirect methods of distance determinations beyond the limits of the trigonometrical method. It is regrettable that no reference is given to the Russell-Hertzsprung diagram in leading up to the spectroscopic parallax determinations. This beautiful spectrum-luminosity relation openly hints toward a means of finding the distance of a star when its spectrum and apparent magnitude are observed, but this book informs the reader only of the closer details in the refined work of Adams and Kohlschütter, concerning the relative intensities of various spectral lines as they depend on absolute magnitude.

The numerous illustrations of the usual spectacles of the universe are well reproduced. The diagrams or figures do not always clarify or aid in the understanding of the text. For example, the ordinate in Fig. 15 of the light curve of Delta Cephei is misleading to the inexperienced, and no explanation is given. Instead of "difference in magnitude," how much easier the apparent magnitude would be for the reader. Such usage is taken for granted by the professional, but liberties may not be taken so lightly in guiding the amateur. A rather unfortunate choice was made in the figure used to illustrate the presence of interstellar calcium as a distance criterion. Without an explanation, the abscissa means nothing; moreover, much new material has been added to this study since 1928, when this diagram first appeared.

Speaking of astronomers and their work in the preface, Dr. Lee states: "I hope this book will give you some understanding of their methods, some appreciation of the relentless care with which their results are checked, and some realization as to how fundamentally important are accurate measurements to the work they have to do." Although in a somewhat haphazard and meandering fashion, perhaps in an effort not to intimidate the beginner, the reader is made aware of the above aims.

SARAH LEE LIPPINCOTT
Sproul Observatory

SOME EARLY TOOLS OF AMERICAN SCIENCE

I. Bernard Cohen. Harvard University Press, Cambridge, 1950. 201 pages. $4.75.

THE SUBJECT of Professor Cohen's book is the history of the natural sciences in 18th-century America, as illustrated by the collections of scientific instruments belonging to Harvard.

So widespread is the belief that Puritan New England was an uncongenial environment for the natural sciences that the many evidences Professor Cohen presents of a flourishing interest in astronomy will surprise some readers. However, "the New England clergymen of the eighteenth century showed no hostility to science," for to them the regular motions of the heavenly bodies, as explained by Newtonian mechanics, were a convincing demonstration of an ordered universe, and hence, of a Creator. At Harvard, Copernican astronomy was taught as early as 1659. The first telescope at Harvard was a refractor of 3½ feet focal length, given by Governor Winthrop in 1672. With this instrument, Thomas Brattle made observations of the comet of 1680 that were used by Isaac Newton in his computation of its orbit.

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ments by Harvard afford an interesting index of continuing attention to astronomy. A brass quadrant was obtained in 1689. For his observations of the solar eclipse of 1703, Brattle used a nonachromatic refractor 4½ feet in length; but both this and the 8-foot refractor acquired in 1712 were telescopes of inferior size and power for that day. Only with a 22-foot refractor in 1722 did Harvard finally obtain a telescope comparable to those then in use at Paris and Greenwich.

The increasing popularity of reflecting telescopes by the middle of the 18th century is illustrated by gifts to Harvard of four reflectors between 1747 and 1761.

With a single exception, all of the instruments mentioned were lost in the disastrous fire of January 24, 1764, which destroyed Harvard Hall, where the library and the scientific instruments of the university were housed. To replace the lost astronomical instruments, new equipment was ordered from London, at a cost of £408: a 4-foot Dollond achromatic refractor, a 2-foot Sisson quadrant (used in 1780 by Samuel Williams to determine the latitude of Cambridge), and a 15-inch Hadley quadrant.

More important than telescopes themselves are the observations made with them. The lack of a fixed observatory with a regular staff, which did not exist at Harvard until little more than a century ago, hindered the systematic use of these instruments. The most important observational results by the Harvard astronomers of the period were those secured on two expeditions. The first, led by John Winthrop, went to Newfoundland to observe contact times of the transit of Venus on June 6, 1761. The second expedition was under Winthrop's successor as Hollis professor, Samuel Williams. He led a party to Long Island in Penobscot Bay, in the present state of Maine, to observe the total solar eclipse of 1780. This was at the height of the Revolutionary War, and as the observing site of the expedition was held by British forces, the party had to proceed under a safe-conduct, which was readily granted. This episode should remind us that the international character of astronomy has been respected in all ages save our own.

An interesting insight into the state of early American astronomy is afforded by the syllabuses of astronomy courses given at Harvard. Professor Cohen has reprinted two such programs. The first outlines a series of lectures, begun in 1747 by John Winthrop, on "The Method of Astronomical Calculation." The principal topics covered are time, the calculation of solar and lunar eclipses, and the prediction of "Moments of Immersions or Emersions of Jupiter's first satellite, according to the Ingenious Method of the Rev. Mr. Pound." This last topic was of very great practical importance 200 years ago, as the observation of eclipses of Jupiter's satellites then afforded the most satisfactory means of determining geographical longitudes.

The primitive state of stellar astronomy is illustrated by Samuel Williams' course of 15 lectures in 1785, which was intended to cover the whole of what was then called practical and theoretical astronomy. Only two lectures treat the stars, and of these one merely describes the constellations. The other consists of "Sydereal Astronomy — The phenomena of double and cloudy stars; — lucid spots; — the milky way; — zodiacal light, etc. The appearances represented by diagrams, and the phenomena shewn by Telescopes."

This description of Professor Cohen's book has been largely confined to its astronomical contents, as these are of more immediate interest to the readers of **Sky and Telescope.** The scope of the book is much wider, for physics, chemistry, biology, and mineralogy also pass successively under review. The 50-odd pages of appendices and notes at the end are directed specifically to the historian of science, but the more general reader will find the main body of the text agreeable and informative.

JOSEPH ASHBROOK
Yale University Observatory

NEW BOOKS RECEIVED

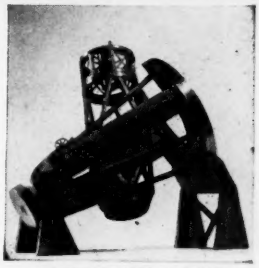
STELLAR EVOLUTION, *Otto Struve*, 1950, *Princeton University Press.* 266 pages. $4.00.

A book based on the author's recent Vanuxem lectures at Princeton, intended as much for physicists, chemists, geologists, as for astronomers. In three principal parts, it discusses the chemical composition of the stars; some problems of stellar evolution; and the origin and development of close double stars.

THE PHILOSOPHY OF MATHEMATICS, *Edward A. Maziarz*, 1950, *Philosophical Library.* 286 pages. $4.00.

Answers to questions of the origin of mathematics are given in this volume, as well as an attempt to integrate the whole philosophy of mathematics.

SCIENCE MODELS



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BY DORRIT HOFFLEIT

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(This is a companion booklet to Harvard College Observatory — The First Century, *published in 1946, 94 pages, 72 illustrations, 75 cents postpaid.)*

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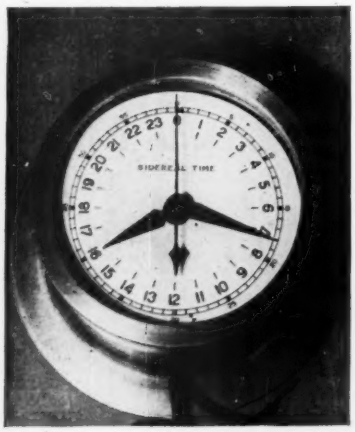

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GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

MAMMOTH AMATEUR SCOPE

A 16-INCH Newtonian reflector was recently completed by William A. Ervin, 3628 Auburn Blvd., North Sacramento, Calif., an amateur telescope builder and a director of the Sacramento Valley Astronomical Society. The event was made the occasion for a meeting of the telescope makers section of the SVAS at the Ervin home on July 5th, at which time the telescope was formally dedicated.

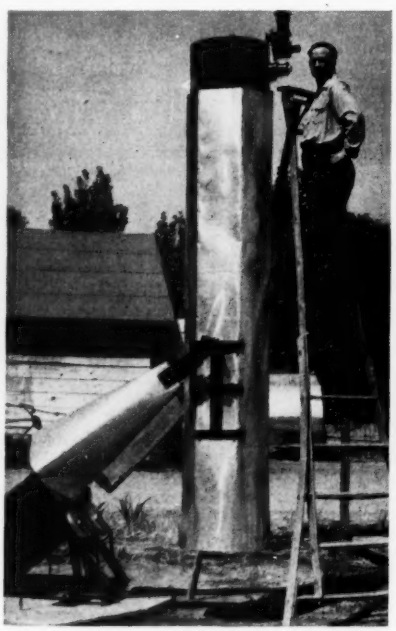
Mr. Ervin, an aircraft painter at McClellan Air Force Base, has his own cabinet shop and has built the telescope from odds and ends and scrapped machinery. Some of the work has been done on machines of his own design and making. While he has previously built a portable 8-inch reflector, this is his first mirror.

The mirror is an f/8, and was ground from a 50-pound pyrex flat three inches thick. It is mounted in an aluminum-cased tube 23 inches in diameter and 11 feet in length. The diagonal is an elliptical obsidian. Eyepiece adjustment is by rack and pinion. The telescope is equipped with an elbowed 10-power finder.

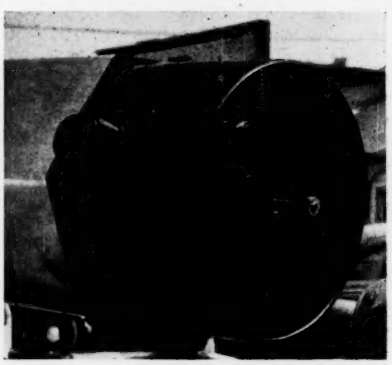
The mounting is of the fork type, with 180-degree swing on the declination axis, eliminating any blind spots. The equatorial mount consists of an inverted automobile engine with the crankshaft as the equatorial axis. The fork is attached to the flywheel, which is supported underneath by two smaller fiber wheels that may be seen in the photograph.

When elevated to the zenith, as shown here, the overall height of the telescope is 13 feet. Its weight with the mounting is approximately 750 pounds.

It is planned to move the instrument to the California State Fair Grounds at Sacramento, where it will be part of the SVAS exhibit during the annual state fair, August 31st through September 10th.



William A. Ervin and his 16-inch reflecting telescope. Photos by Carl W. Anderson.



The eyepiece end of the Ervin 16-inch reflector, showing the diagonal support and the elbow-type finder.

CARL W. ANDERSON
Route 1, Box 7624
Sacramento, Calif.

SOLAR-LUNAR CAMERA

AFTER several years of casual observing of the sky in general, I have finally found my niche: concentrated study of the sun and moon. These two bodies directly affect our everyday life. So I have built some special photographic equipment and an ultra-short-wave receiver with which to study radiation, a phase of astronomy in which I have found no other amateurs working.

After much experimenting, I have found the camera equipment very satisfactory. I use two Kine Exakta cameras, one loaded with Kodachrome and the other with Panatomic X. They are instantly interchangeable on the lens mount. The front lens is an Eastman Aero Ektar, 24 inches focal length, f/6. The rear lens is a war surplus eyepiece of 1¼-inch focal length, f/0.8. All air surfaces of both lenses are coated. The eyepiece lens is highly corrected and is composed of six elements.

After experimenting with motor drives, I went to the other extreme and built a

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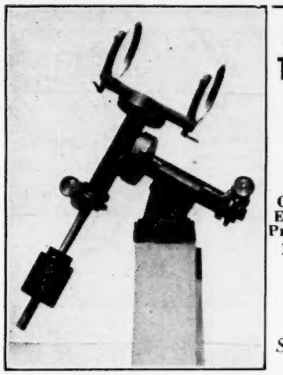

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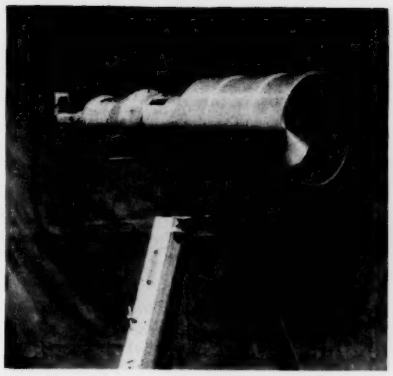


W. C. Cheney's camera for solar and lunar photography. The small camera may be instantly replaced with another loaded with a different kind of film.

very rigid simple tripod. As all exposures are fractions of a second and the cameras are of the reflex type, this has proved most satisfactory.

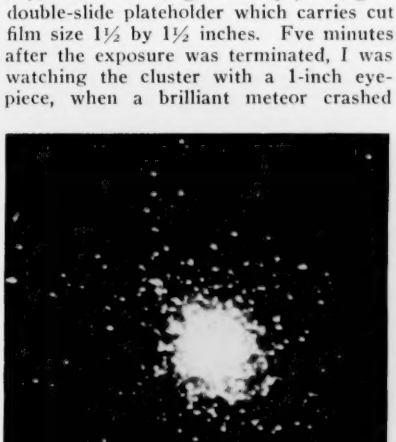
The disk of the full moon measures about ¾ inch in diameter and is very clear and sharp. Some years past I took several Kodachrome shots of a lunar eclipse with an 8-inch focal length lens and found that the color brought out the varied density of the shadow whereas black-and-white pictures did not.

In connection with sunspot photography, I expect to keep a concurrent record of radio radiation intensity. Some of these observations will be made from my shop here and others, when conditions permit, from the 7,000-foot level on Mt. Rainier.

W. C. CHENEY
P. O. Box 3282
Seattle 14, Wash.

OBSERVING EQUIPMENT

ENCLOSED IS a photograph of the globular cluster M5 made with my 12½-inch reflecting telescope, using a double-slide plateholder which carries cut film size 1½ by 1½ inches. Fve minutes after the exposure was terminated, I was watching the cluster with a 1-inch eyepiece, when a brilliant meteor crashed



The globular cluster M5 in Serpens, photographed by E. J. Roy on June 4, 1950, two-hour exposure, with a 12½-inch reflector.

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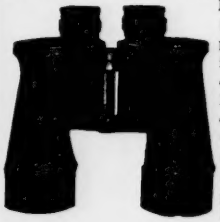

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Diameter	Focal Length	Each
54 mm (2⅛")	600 mm (23½")	$12.50
76 mm (3")	381 mm (15")	21.00
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83 mm (3¼")	876 mm (34½")	28.00
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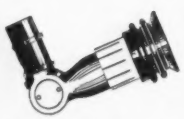

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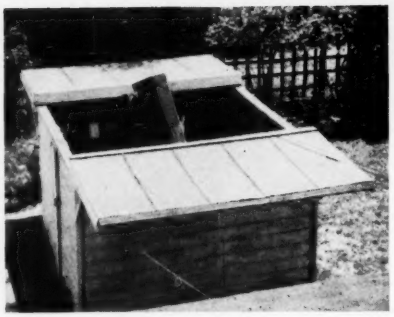


Mr. Roy's reflector is operated in this typical back-yard observatory.

through and neatly bisected the field. The flash of light was positively astonishing, and I recoiled back from the eyepiece not knowing for an instant what had happened.

My son, standing nearby, said, "You missed seeing a beautiful meteor." But I explained to him that had our two-hour exposure on M5 gone only five more minutes we would have had an unusual photograph.

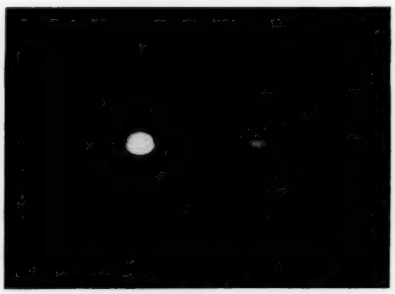
The octagon wooden tube of this telescope and its mounting are my own design. The mirror and elliptical flat are the work of Chester Cook, of the Boston Amateur Telescope Makers. I have made several mirrors, including a 10-inch, but getting together a mounting and observatory was enough at one time, and I am sure I have a better figure than if I had been the mirror maker.

I have a Bausch & Lomb Aero Tessar 4-inch 24-inch-focus camera mounted above the main tube. As this patrol camera is guided with the 100-inch focal length main mirror, I get needle-point images on faint stars. By means of an auxiliary motor, the clock can be run at half speed or double speed to make guiding corrections. The switches for the different speeds are at the eyepiece.

For photography with the main mirror, I have devised a micrometer holder with a faintly illuminated reticle in a ½-inch eyepiece. The filmholder is in the center of a small table which can be moved by two screws at right angles to each other. The guide star can be accurately held on the intersection of the crosswires by careful manipulation of the screws; the table can be rotated through a complete circle. This idea was obtained from the Porter drawings of the Hale telescope, particularly that on the back cover of **Sky and Telescope**, May, 1948.

E. J. ROY
Arcade Bldg.
Kankakee, Ill.

The mounting of the Roy 12½-inch reflector, and part of the octagonal tube.



Saturn, as photographed by E. J. Roy on May 10, 1950, projected through a ½-inch eyepiece. The rings were inclined about five degrees to the line of sight.

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OBSERVER'S PAGE

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VISUAL OBSERVING PROGRAMS FOR AMATEURS — VI

Instruments — (continued)

LARGER REFRACTORS. A number of amateurs who use refractors of 4-inch up to 7-inch aperture have found it possible to mount them on piers usually protected by a building with a sliding roof. Other amateurs, including myself, have not found this feasible because of tree conditions, lack of back-yard room, frequent moves, or other reasons.

I have a 6.2-inch refractor of 93-inch focal length, pictured here. It is too large and unwieldy to be set up except for state occasions such as visitors, or when Mars and Saturn are visible or some faint variable star requires close attention. I keep this telescope, however, for three reasons: It is definitely better on the planets than my present 6-inch f/8 reflector and my former 8¾-inch semiprofessional f/8.6 reflector; the views it presents of variable star fields and nebulae with wide-angle 62x or 74x Erfle eyepieces are beautiful beyond belief; hope rises eternal in the human breast — I plan someday to mount this on a pier, and I can then dispose of my portable instruments.

This telescope is only a little better on the sun than the small refractor that I habitually use for solar work, because above about 50x the atmosphere in New England is usually so unsteady that there is an actual loss in details when one goes to powers of 93 and above. In excellent seeing one can occasionally use a power of 85 to advantage.

The illustration shows the telescope equipped with a 1.5-inch Erfle eyepiece which gives a power of 62 and a field of 70 minutes, larger than an AAVSO "d" type chart. A 1.25-inch Erfle is interchangeable with the above, giving a power of 74 and a field of one degree. To accommodate these large eyepieces, the rack-and-pinion focusing tailpiece is made with a 2″ inside diameter eyepiece tube. A 2″-1¼″ bushing is inserted in the tailpiece tube when I use standard 1¼″ outside diameter eyepieces and solar eyepiece assemblies.

David W. Rosebrugh's 6.2-inch refractor of 93 inches focal length.

The finder has a 60-mm. objective and a field of four degrees at 12x; a large finder is needed with a large instrument. The telescope can be moved longitudinally in its heavy sheet-iron cradle for balance. Dewcaps are provided for the telescope and finder objectives. A Y-shaped brace at the midpoint of the tripod legs helps to overcome the weakness of the tripod in torsion about the vertical axis, which is the principal cause of shake in a tripod. All clamp bolts on the tripod can be drawn tight with a wrench. With the two hand controls, this telescope is satisfactory for viewing Mars and Saturn with powers up to 280 or 408.

For variable star work I have a very light altazimuth mounting with offset fork-type head and cradle mounting, which weighs only 20 pounds. This can be substituted for the heavy mounting when I do not wish to take the time to erect the equatorial mounting piecemeal in the backyard. For powers up to 124, which shows 14th-magnitude stars, this mounting is entirely serviceable; the ensemble can be carried out into the yard in two parts, the first being the tripod and mounting and the second the telescope itself.

The powers most used with this telescope are 74 for variable stars, 50 on the sun, and 186 and 280 on the moon and planets. I have also a 68x terrestrial eyepiece for spyglass purposes.

This 6.2-inch refractor was made by three amateurs. One made the objective and roughed out the tube, another the objective cell and focusing tailpiece, and I made the mounting and did the general assembly. This ensemble cost me $700 in cash paid to the other two amateurs and for eyepieces and supplies. It has taken me about 300 hours to improve the tube, make the mounting, the finder subassembly, the solar and zenith prisms, and to assemble the entire telescope in usable form. Storage boxes and carrying cases for accessories have probably taken me another 100 hours of work.

DAVID W. ROSEBRUGH
79 Waterville St.
Waterbury 10, Conn.

PHASES OF THE MOON

Last quarter	.....	September 4, 13:53
New moon	.....	September 12, 3:29
First quarter	.....	September 18, 20:54
Full moon	.....	September 26, 4:21
Last quarter	.....	October 4, 7:53

	September		Distance	Diameter
Apogee	3d	10h	251,300 miles	29′ 33″
Perigee	15d	7h	227,500 miles	32′ 39″
	October		**Distance**	**Diameter**
Apogee	1d	4h	251,800 miles	29′ 29″

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TOTAL ECLIPSE OF THE MOON

SEPTEMBER'S main celestial show will be the total eclipse of the moon, so be sure to reserve the night of September 25-26 for that event. Totality occurs during evening hours throughout the United States; on the West Coast the moon will be entering the penumbra as it rises. As seen by the diagram, the moon will not pass deeply into the umbra. The magnitude of the eclipse is 1.084, whereas for a perfectly central eclipse it would be 1.83.

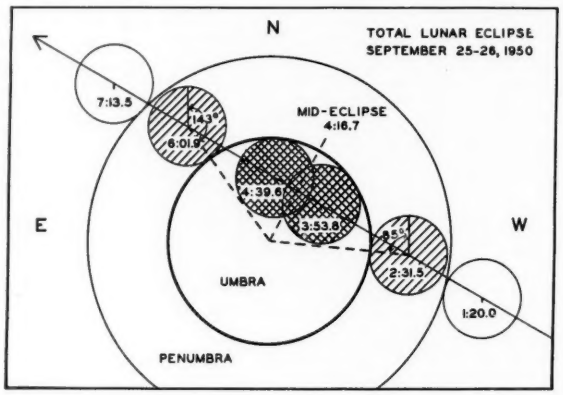
Totality is only 46 minutes long, but from first entrance into the penumbra to exit takes five hours, 53.5 minutes. Both facts are associated with the moon's greater than average distance during the eclipse, some 245,400 miles. The earth's principal shadow or umbra at that distance is about 5,700 miles across, or 81 minutes of arc diameter in the sky (adding some 50 miles for the earth's atmosphere). The partial shadow or penumbra is approximately 10,000 miles in diameter at that distance.

As the moon passes through the penumbra, little change in its glaring brightness can be noticed until it nears the umbra. Then a brownish or gray tint may be viewed on the east limb where contact with the umbra is to be made. After first contact, the earth's shadow on the moon appears black by contrast. But as totality commences, the moon takes on a copperish color caused by refraction of sunlight in our atmosphere.

Observers with telescopes may watch for changes in the appearance of various craters, ray systems, and maria as the eclipse progresses. They may scrutinize the darkened moon for supposed lunar meteors, possibly to confirm the existence of some lunar atmosphere. No stars brighter than 7th magnitude will be occulted; several faint stars, including two shown in the Skalnate Pleso **Atlas,** will be occulted during the eclipse for some observers.

There will be no other total lunar eclipses visible from the United States until January 29, 1953, but a partial one will be seen on February 10, 1952.

EDWARD ORAVEC



A cross-section of the umbra and penumbra of the earth's shadow, showing positions of the moon during the eclipse. Total eclipse occurs while the moon is in the umbra, from 3:53.8 to 4:39.6 UT. Position angles of the points of first and last contact with the umbra are, respectively, 85° east of north, and 143° west of north.

OCCULTATION PREDICTIONS

September 2-3 **17 Tauri** 3.8, 3:41.9 +23-57.5, 20, Im: **G** 11:37.2 −1.4 +1.4 64; **H** 11:09.8 −2.6 +0.5 97; **I** 11:23.4 −1.1 +1.9 56. Em: **H** 12:23.7 −1.2 +3.2 207; **I** 12:44.6 −1.7 +0.8 255.

September 2-3 **q Tauri** 4.4, 3:42.2 +24-18.7, 20, Im: **F** 12:25.5 −2.6 +0.2 79; **H** 11:49.8 −1.1 +3.2 30. Em: **F** 14:01.1 −2.2 +0.3 246; **H** 13:07.3 −2.8 −0.5 276.

September 2-3 **20 Tauri** 4.0, 3:42.8 +24-12.8, 20, Im: **F** 12:58.3 −2.6 −2.4 116; **H** 11:56.9 −2.1 +1.5 68; **I** 12:24.5 −0.6 +3.5 19. Em: **F** 14:10.2 −2.2 +2.4 213; **H** 13:31.0 −2.2 +1.2 241.

September 16-17 **b Scorpii** 4.8, 15:48.0 −25-36.0, 5, Im: **H** 3:09.0 −1.3 −0.9 87. Em: **H** 4:17.8 −1.1 −1.7 293.

September 20-21 **Omega Sagittarii** 4.8, 19:52.8 −26-26.0, 9, Im: **A** 0:18.5 −1.4 +1.3 28; **B** 0:20.8 −1.2 +1.2 23; **C** 0:06.2 −1.6 +1.6 30; **D** 0:10.2 −1.4 +1.7 21; **E** 23:43.4 −1.8 +2.3 26; **F** 23:10.6 −1.8 +2.0 51. Em: **A** 1:19.8 −2.4 −0.8 293; **C** 1:09.7 −2.6 +0.5 293; **E** 0:35.3 −2.0 −0.3 308; **F** 0:21.3 −1.8 +0.2 290.

September 20-21 **A Sagittarii** 5.0, 19:55.9 −26-20.0, 9, Im: **A** 1:54.2 −1.4 0.0 65; **B** 1:52.7 −1.4 0.0 59; **C** 1:46.4 −1.7 +0.2 64; **D** 1:44.0 −1.5 +0.3 55; **E** 1:22.5 −1.7 +1.0 48; **F** 0:57.6 −2.2 +1.4 59; **H** 0:25.0 −1.5 +1.9 58. Em: **A** 3:09.8 −1.2 −0.5 247; **C** 3:05.6 −1.4 −0.3 248; **E** 2:40.4 −2.2 −0.3 272; **F** 2:24.7 −2.5 +0.2 265; **H** 1:36.9 −1.6 +0.6 283.

September 26-27 **Epsilon Piscium** 4.4, 1:00.3 +7-37.3, 15, Im: **G** 8:07.4 −1.5 +0.8 67; **H** 7:43.7 −3.0 +0.5 91; **I** 7:53.0 −1.3 +1.4 56. Em: **G** 9:22.8 −1.0 +1.1 218; **H** 8:46.0 −0.2 +3.3 184; **I** 9:11.2 −1.2 +1.2 226.

For standard stations in the United States and Canada, for stars of magnitude 5.0 or brighter, data from the **American Ephemeris** and the **British Nautical Almanac** are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computations of fairly accurate times for one's local station (long. **Lo,** lat. **L**) within 200 or 300 miles of a standard station (long. **LoS,** lat. **LS**). Multiply **a** by the difference in longitude (**Lo — LoS**), and multiply **b** by the difference in latitude (**L — LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	**E** +91°.0, +40°.0
B +73°.6, +45°.6	**F** +98°.0, +31°.0
C +77°.1, +38°.9	**G** +114°.0, +50°.9
D +79°.4, +43°.7	**H** +120°.0, +36°.0
I +123°.1, +49°.5	

SATURN IN SEPTEMBER

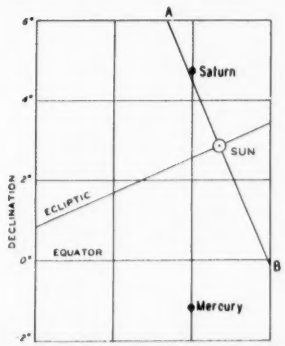
ORDINARILY, when a superior planet is in conjunction with the sun near the middle of the month, the Observer's Page would dismiss it with a single sentence, but Saturn this month deserves more attention. On September 14th, the earth passes through the plane of Saturn's rings. This is only seven days before the ring plane passes through the sun. (See page 95 of the February, 1950, issue for a description and graph of the phases of the rings.)

Most observers, however, will not see the rings at an inclination smaller than that of December, 1949, for conjunction of Saturn and the sun occurs on September 16th. During the total phase of the solar eclipse on the 12th of this month, the planet will be very close to the sun, much as it was during the total eclipse of July 9, 1945. We wonder if any of the fortunate few on Attu and Agattu islands will have a telescope to view a ringless Saturn.

A thoughtful communication from Fred Parker, Clayton, Ind., points out a seeming inconsistency in the order of events given above. The date of conjunction, September 16th, is between the predicted times when the earth and the sun are in turn in the plane of the rings. Analyzing the graph and diagram in the February article, however, he reasoned that the ring plane should pass first through the sun and then through the earth, with both phenomena taking place before conjunction of planet and sun.

The misunderstanding arises from failure to take into account the latitude of Saturn; this was tacitly omitted from the February discussion. The three-dimensional concepts involved are difficult, but some help can be gained by imagining oneself on Saturn, at present situated above the plane of the ecliptic. The earth would appear above the sun also, near superior conjunction, just as with an inferior planet to us. The ring plane must be imagined slowly creeping "westward" across the earth's orbit (radius six degrees as seen from Saturn), with the southern side of the rings preceding as seen from the earth. The fast-moving earth approaches its superior conjunction with the sun, but two earth days earlier cuts the ring plane, passing from the southern side to the northern. Finally, the ring plane reaches the sun, on September 21st.

A conjunction of Mercury and Saturn on September 16th is the middle one in a series of three. The first one, on August 16th, near the time of Mercury's greatest elongation east, was favorably observed in evening skies of the Southern Hemisphere. The third one is a very close conjunction on October 6th, near Mercury's greatest elongation west, easily seen in northern morning skies. The September conjunction takes place while Mercury is in retrograde motion, and the circumstances deserve special notice.



At the instant of conjunction, the two planets will have the same right ascension and will appear on the celestial sphere relative to the sun as shown in the accompanying diagram. The unusual feature is that Saturn will be a "morning star" while Mercury will still be an "evening star" (one planet near opposition, and one near inferior conjunction). According to definition, the transition from evening to morning star takes place when a planet crosses the line AB perpendicular to the ecliptic. It is then of the same celestial longitude as the sun. The paradox of conjunction in right ascension of a morning and evening object arises from their difference in latitude, together with the inclination of the ecliptic to the parallels of declination near an equinox.

PAUL W. STEVENS
2322 Westfall Rd.
Rochester 18, N. Y.

THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Sun. The lone total solar eclipse in 1950 takes place on September 12th, invisible from the United States. See page 242, August issue, for more details.

Mercury enters the morning sky on September 17th. It will rise 1½ hours before the sun on the last few days of the month, and will be just above Venus and Saturn, a fine sight in the early dawn sky.

Venus rises about 1½ hours before the sun on the 15th, and is near its faintest brightness, magnitude −3.3. On the 9th, Venus passes 41′ north of Regulus in Leo. Saturn and Venus will be 33′ apart (geocentrically) on September 29th, Venus north of and four magnitudes brighter than Saturn.

Earth arrives at heliocentric longitude 0° on September 23rd at 14:44 UT. Autumn commences in northern latitudes and the spring season south of the equator, with day and night approximately equal over the earth.

The **moon** will be totally eclipsed on September 25-26, the event entirely visible from the Americas. This eclipse occurs at the ascending node of the moon, which coincided with the vernal equinox last month. Details and a chart are on page 275 and 282.

Mars, in the southwestern sky in the early evening, continues its eastward motion in Libra and Scorpius. Compare Mars and its "rival," Antares, both red and of about the same brightness.

Jupiter dominates the night sky. It can be found without optical aid with the sun above the horizon if one knows just where to look. Telescopically, Jupiter is a fine object, with an equatorial diameter of 49″, polar diameter 3″ less, on the 15th. Configurations of its four bright satellites are given elsewhere in this department.

Saturn is in conjunction with the sun in the middle of the month, but it may be seen rising one hour before the sun the last few days of September.

Uranus may be located after midnight in western Gemini, with the aid of opera glasses. The planet is moving eastward slowly about 2° south of Epsilon Geminorum.

Neptune is too near the sun to be observed.

E. O.

Planetarium Notes

BALTIMORE: *Davis Planetarium.* Maryland Academy of Sciences, Enoch Pratt Library Building, 400 Cathedral St., Baltimore 1, Md., Mulberry 2370.

SCHEDULE: 4 p.m. Monday, Wednesday, and Friday; Thursday evening, 7:45, 8:30, 9:30 p.m. Admission free. Spitz projector. Director, Paul S. Watson.

BOSTON: *Little Planetarium.* Boston Museum of Science, Science Park, Boston 15, Mass. Richmond 2-1410.

SCHEDULE: Tuesday thru Friday at 3:30 p.m.; Saturday, 2:00 and 3:30 p.m.; Sunday, 3 and 4 p.m. Spitz projector. In charge, Charles A. Federer, Jr.

BUFFALO: *Buffalo Museum of Science Planetarium.* Humboldt Parkway, Buffalo, N. Y., GR-4100.

SCHEDULE: Sundays, 2:00 to 5:30 p.m. Admission free. Spitz projector. For special lectures address Elsworth Jaeger, director of education.

CHAPEL HILL: *Morehead Planetarium.* University of North Carolina, Chapel Hill, N.C.

SCHEDULE: Daily at 8:30 p.m.; Saturday and Sunday at 3:00 p.m. Zeiss projector. Director, Roy K. Marshall.

CHICAGO: *Adler Planetarium.* 900 E. Achsah Bond Drive, Chicago 5, Ill., Wabash 1428.

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m. Zeiss projector. Director, Wagner Schlesinger.

KANSAS CITY: *Kansas City Museum Planetarium.* 3218 Gladstone Blvd., Kansas City 1, Mo., Chestnut 2215.

SCHEDULE: Wednesday and Saturday, 3:30 p.m.; Sunday, 3:00 and 5:00 p.m. Spitz projector. Director, Charles G. Wilder.

LOS ANGELES: *Griffith Observatory and Planetarium.* Griffith Park, P.O. Box 9787, Los Feliz Station, Los Angeles 27, Calif., Olympia 1191.

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m.; extra show on Sunday at 4:15 p.m. Zeiss projector. Director, Dinsmore Alter.

NEW YORK CITY: *Hayden Planetarium.* 81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500.

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.; Wednesdays and Fridays, 11 a.m., for school groups. Zeiss projector. Curator, Gordon A. Atwater.

PHILADELPHIA: *Fels Planetarium.* Franklin Institute, 20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Locust 4-3600.

SCHEDULE: Tuesdays through Sundays, 3 p.m.; Saturdays, 11 a.m.; Saturdays, Sundays, and holidays, 2 p.m.; Wednesdays, Fridays, and Saturdays, 8:30 p.m. Zeiss projector. Director, I. M. Levitt.

PITTSBURGH: *Buhl Planetarium and Institute of Popular Science.* Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300.

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 3:15 and 8:30 p.m. Zeiss projector. Director, Arthur L. Draper.

SPRINGFIELD, MASS.: *Seymour Planetarium.* Museum of Natural History, Springfield 5, Mass.

SCHEDULE: Tuesdays, Thursdays, and Saturdays at 3 p.m.; Tuesday evenings at 8 p.m.; special star stories for children on Saturdays at 2 p.m. Admission free. Korkosz projector. Director, Frank D. Korkosz.

STAMFORD: *Stamford Museum Planetarium.* Courtland Park, Stamford, Conn.

SCHEDULE: Sunday, 4:15 p.m. Special showings on request. Admission free. Spitz projector. Director, Robert E. Cox.

DEEP-SKY WONDERS

DOWN in the vacant spaces above the middle of Capricornus lie two Messier objects, M72 and M73. The first is NGC 6981, located at 20h 50m.7, −12° 44′. It is a 10th-magnitude globular cluster, 5′ in diameter, a small circular patch with an unusually fuzzy appearance. It was discovered on August 29, 1780, by the industrious Méchain in France. Of the globulars, Helen Sawyer Hogg credits William Herschel with 33; James Dunlop, almost forgotten today, with 21; Messier with only 14; Pierre Méchain and John Herschel with five each; and the Abbe de Lacaille with four. Others have two or one.

Smyth lists M72 under Capricornus, although today it is over the boundary into Aquarius by about two whole degrees, because of precession changes since 1844, when **Celestial Cycle** was published.

M73, NGC 6994, 1½° east of M72, is listed by Shapley and Davis as an open cluster, but it is not included in Shapley's list of galactic clusters; neither is it mentioned by Smyth or Webb. It is not included in any of this writer's notes nor, according to an incomplete check of **Sky and Telescope**, has it ever been described in this column. However, Smyth, in the **Bedford Catalogue**, 1844, describes M73 as "a trio of 10th-magnitude stars in a poor field." The NGC description is **Cl, eP, viC, no neb**, meaning cluster, extremely poor, very irregularly compressed, no nebula.

WALTER SCOTT HOUSTON

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the **American Ephemeris and Nautical Almanac.**

Configurations at 4h 30m for an Inverting Telescope

Sept.	West							East							
1	○2·			4·	1·	○		·3							
2		4·		·2		○	1·		·3						
3	4·				·1	○	·2	3·							
4	·4				3·	○·		2·							
5		·4		3·	2·	○									·1●
6			·4	·3		·2·	○								
7					·4	·3	○	·1	·2						
8					1·		○·	·3							·4●
9				2·			○	1·	·4	·3					
10					·1		○·2		3·		·4				
11	○3·						○	1·	2·			·4			
12				3·	2·		○1						·4		
13				·3		·2	1·○					4·			
14					·3		○	·1	·2		4·				
15					1·		○	2·	·3	4·					
16				2·		4○·		·1		·3					
17					4·	·1	○		3·						·2●
18			4·			3○·		1·	2·						
19		4·		3·		2··	1○								
20	○1·	4·		·3	·2		○								
21		·4			·3		○	·1	·2						
22			·4		1·		○	½							
23				·4	2·		○	·1		·3					
24					¼		·○2		3·						
25							○	3·	¼	2·					
26				3·		¾	○			·4					
27			3·		·2		1○·				·4				
28				·3			○	·2				·4			·1●
29					1·	○	2·					4·			·3●
30				2·		○	·1		·3		4·				

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown. Add one hour for daylight time.

VARIABLE STAR MAXIMA

September 5, S Canis Minoris, 7.5, 072708; 6, R Ursae Majoris, 7.6, 103769; 8, R Leonis Minoris, 7.2, 093934; 16, R Centauri, 5.9, 140959; 27, R Phoenicis, 7.8, 235150; 30, SS Virginis, 6.9, 122001; 30, R Aurigae, 7.8, 050953. October 5, RS Cygni, 7.4, 200938.

These predictions of variable star maxima are by Leon Campbell, honorary recorder of the AAVSO. Only stars are included whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

MINIMA OF ALGOL

September 2, 13:22; 5, 10:10; 8, 6:59; 11, 3:47; 14, 0:36; 16, 21:24; 19, 18:13; 22, 15:02; 25, 11:50; 28, 8:39. October 1, 5:28; 4, 2:16; 6, 23:05.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See Sky and Telescope, Vol. VII, page 260, August, 1948, for further explanation.

PREDICTIONS OF BRIGHT ASTEROID POSITIONS

No. 27	**Euterpe**		Mag. 9.0	
	h	m	°	′
Oct. 6	2	27.6	+11	47
16	2	20.3	+11	09
26	2	11.1	+10	23
Nov. 5	2	01.3	+9	37
15	1	52.6	+9	00
25	1	46.2	+8	38
No. 12	**Victoria**		**Mag. 9.2**	
	h	m	°	′
Sept. 26	1	51.4	+20	59
Oct. 6	1	43.5	+19	48
16	1	34.2	+18	15
26	1	25.1	+16	29
Nov. 5	1	17.4	+14	43
15	1	12.2	+13	09

The above are predicted positions in right ascension and declination for the epoch 1950.0, for 0h Universal time. The magnitude is that expected at opposition. In each case the motion of the asteroid is retrograde.

SLOW NOVA DISCOVERED IN SCORPIUS

A slowly brightening object, possibly a nova, was discovered in Scorpius by Dr. Fritz Zwicky, of Mount Wilson and Palomar Observatories, on July 20th. The magnitude of the object was about 7.5. Since most novae become suddenly bright and fade away more slowly, this star is of unusual interest. As late as July 14th no star brighter than the 13th magnitude was visible in this location.

The nova is unfavorably placed for many northern observers, at 17h 42m.4 and −33° 59′. This is about four degrees northeast of Shaula, the brighter star in the sting of the Scorpion.

By August 7th, however, the nova had apparently faded to the 11th magnitude, according to reports received at the Harvard clearinghouse from Tonanzintla Observatory in Mexico and the University of Michigan Observatory.

HERE AND THERE WITH AMATEURS

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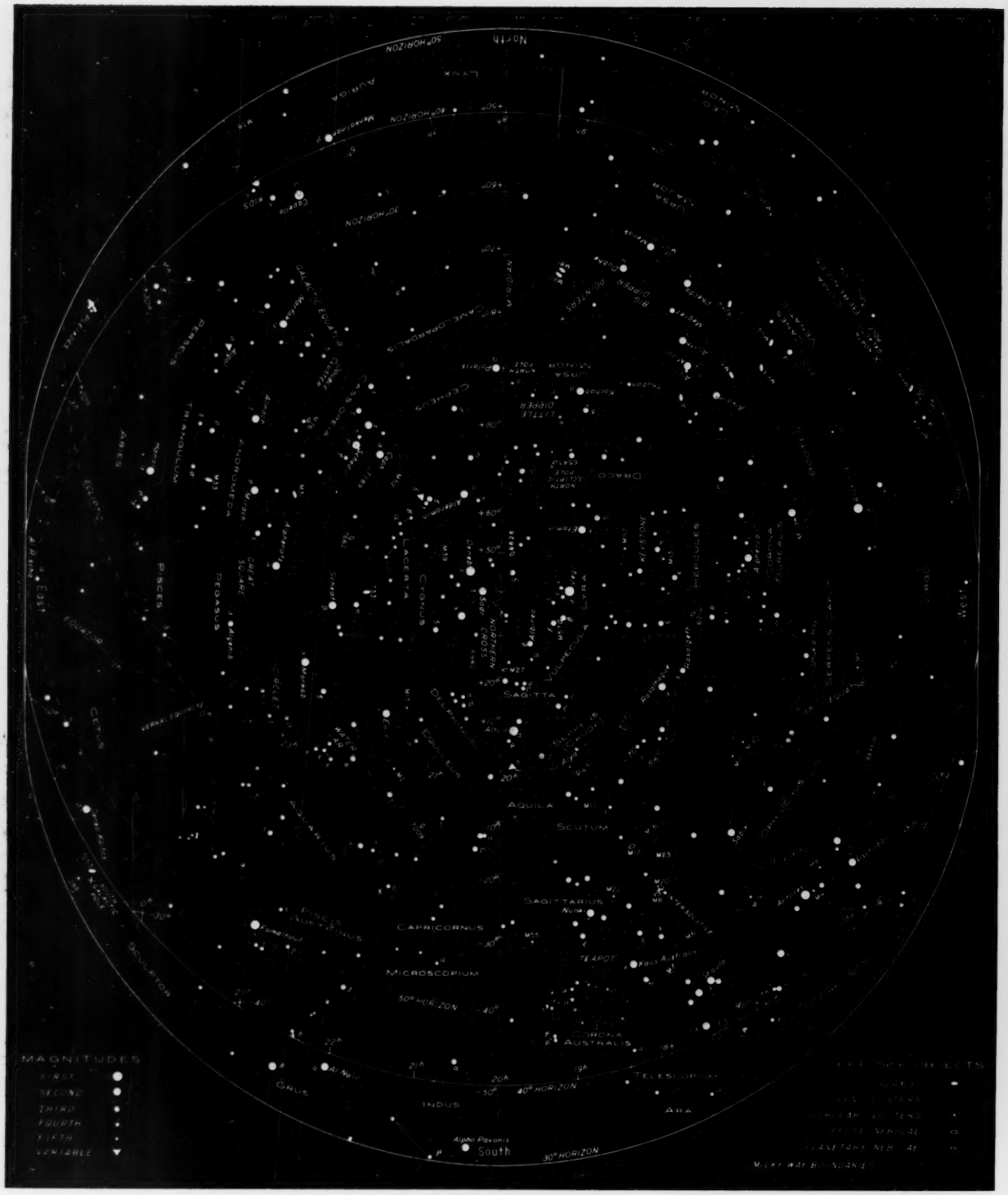
State	City	Organization	Time	Meeting Place	Communicate With
ALABAMA	Gadsden	Ala. A.A.	7:30, 1st Thu.	Ala. Power Audit.	Brent L. Harrell, 1176W or 55
ARIZONA	Phoenix	*Phoenix Obs. Ass'n.	8:00, 1st, 3rd Tue.	Phoenix College	Paul E. Griffin, 1708 S. 3rd St.
CALIFORNIA	Los Angeles	L.A.A.S.	7:45, 2nd Tue.	Griffith Obs.	H. L. Freeman, 853½ W. 57 St.
	Norwalk	Excelsior Tel. Club	7:00, Thu.	Excelsior Union H.S.	Geo. F. Joyner, 12008 E. Sproul St.
	Oakland	*Eastbay A.S.	8:00, 1st Sat.	Chabot Obs.	Miss A. Roemer, 1556 Everett, Alameda
	Palo Alto	*Peninsula A.S.	7:30, 1st Fri.	Community Center	Mrs. D. Rossiter, 922 Roble Ave., Menlo Pk.
	Sacramento	*Sac. Val. A.S.	8:00, 1st Tue., bi-mon.	Sacramento College	Mrs. Helen Schopke, 3111 12th Ave. (17)
	San Diego	Ast. Soc. of S.D.	7:30, 1st Fri.	504 Electric Bldg.	W. T. Skilling, 3140 Sixth Ave.
	San Diego	A.T.M. Ast. Club	7:30, 2nd, 4th Mon.	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, Bayview 3757
COLORADO	Denver	*Am. Tel. Cl. of Den.	8:00, 2nd, 4th Mon.	Chamberlin Obs.	W. E. Johnson, 264 S. Gilpin St.
CONNECTICUT	New Haven	†A.S. of New Haven	8:00, 4th Sat.	320 York St.	Mrs. Helen Velardi, 437 Wash., N'th Haven
	Norwalk	Norwalk A.S.	8:00, Last Fri.	Private houses	Mrs. A. Hamilton, 4 Union Pk., 6-5947
	Stamford	*Stam. Museum A.A.	8:00, 3rd Fri.	Stamford Museum	Thomas J. Page, 52 Frank St.
DIST. COL.	Washington	†Nat'l. Cap. Ast'mers	8:00, 1st Sat.	Comm. Dept. Audit.	Janet Perkins, 2141 Eye St. NW (7), RE 7676
FLORIDA	Daytona Beach	D. B. Stargazers	8:00, Alt. Mon.	500 S. Ridgewood Ave.	Rolland E. Stevens, 500 S. Ridgewood
	Jacksonville	*J.A.A.C.	8:00, 1st, 3rd Mon.	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
	Key West	†Key West A.C.	8:00, 1st Wed.	Private homes	W. M. Whitley, 1307 Div. St., 724-R
	Miami	South'n Cross A.S.	7:30, Every Fri.	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26 Rd.
GEORGIA	Atlanta	Atlanta Ast'mers	7:30, 2nd Fri.	Agnes Scott College	W. H. Close, 225 Forkner Dr., Decatur
ILLINOIS	Chicago	†*Burnham A.S.	8:00, 2nd Tue.	Chi. Acad. of Sci.	Wm. Callum, 1435 Winona St.
	Geneva	*Fox Valley A.S.	8:00, 1st Tue.	Geneva City Hall	Joseph Zoda, 501 S. 6th St., St. Charles
	Moline	†*Popular A.C.	7:30, Wed.	Sky Ridge Obs.	Carl H. Gamble, 3201 Coaltown Rd.
INDIANA	Indianapolis	†Indiana A.S.	2:15, 1st Sun.	Riley Library	Clark B. Hicks, 305 Ruckle St.
KANSAS	Topeka	*Topeka A.A.S.	7:30, 2nd Mon.	Topeka H.S.	Miss N. Utschen, 1607 Wayne Ave.
	Wichita	†*Wichita A.S.	8:00, 1st Wed.	.....	Dollie Ratcliff, 801 Maple, 2-1822
KENTUCKY	Louisville	†L'ville A.S.	8:00, 1st Tue.	Univ. of Louisville	B. F. Kubaugh, 621 34th St.
	Owensboro	†*Owensboro A. C.	8:00, 3rd Sat.	Public Library	Hermann Batt, 1507 Hathaway St.
LOUISIANA	New Orleans	A.S. of N.O.	8:00, Last Wed.	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
MAINE	Portland	†A.S. of Maine	8:00, 2nd Fri.	Private homes	H. Harris, 27 Victory Ave., S. Portland
MASSACHUSETTS	Cambridge	†*Bond A.C.	8:15, 1st Thu.	Harvard Obs.	C. A. Federer, Jr., Harvard Observatory
	Cambridge	†*A.T.M.s of Boston	8:00, 2nd Thu.	Harvard Obs.	H. Smith, 26 Kingman St., Weymouth, 9-3438-R
	Springfield	†*S'field Stars	8:00, 2nd Wed.	Private homes	F. D. Korkosz, Mus. Nat. Hist., 2-4317
	Worcester	†*Aldrich A.S.	7:30, 1st, 3rd Tue.	Mus. Natural Hist.	Ralph A. Wright, 4 Mason St.
MICHIGAN	Ann Arbor	†Ann Arbor A.A.A.	7:30, 2nd Mon.	U. of Mich. Obs.	Stewart W. Taylor, 1106 Birk Ave.
	Battle Creek	†B. C. A.A. Club	8:00, 2nd Fri.	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
	Detroit	†*Detroit A.S.	3:00, 2nd Sun.	Wayne U., State Hall	E. R. Phelps, Wayne University
	Detroit	†*N.W. Detroit A.S.	8:00, 1st Tue.	Redford H. S.	John W. Broxholm, 21412 Pickford
	Kalamazoo	†Kalamazoo A.A.A.	8:00, Sat.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
	Lansing	†*Lansing A.A.	8:00, 1st, 3rd Wed.	Technical H. S.	Mrs. T. A. Louden, 940 Bensch St. (14)
	Pontiac	†*Pontiac A.A.A.	8:00, 3rd Sun.	Cranbrook Inst.	Mrs. M. Chircop, 147 Prospect St., 21455
MINNESOTA	Duluth	†*Darling A.C.	8:00, 1st, 3rd Fri.	Darling Obs.	Mrs. A. Lynch, 1911 Wisconsin, Superior, Wis.
	Minneapolis	M'polis A.C.	7:30, 1st, 3rd Wed.	Public Library	Mrs. M. G. Simpson, 3220 Clinton, Colfax 4331
	St. Paul	*St. Paul Tel. Club	7:30, 2nd, 4th Wed.	Macalester Coll.	Mrs. H. Wolcott, 1705 Scheffer Ave. (5)
MISSOURI	Fayette	†*Central Mo. A.A.	7:30, Last Sat.	Morrison Obs.	R. C. Maag, 611 Bluff St., Fulton
	Kansas City	†*A.A. & T.M.s	8:00, 4th Sat.	Private homes	Reginald Miller, Merriam, Kans.
	St. Louis	†St. Louis A.A.S.	8:00, Sat.	Private homes	A. M. Obrecht, 2913 Park Ave.
NEVADA	Reno	A.S. of Nev.	8:00, 4th Wed.	Univ. of Nevada	E. W. Harris, University of Nevada
NEW JERSEY	Caldwell	West Essex A.A.	8:00, 2nd Mon.	Caldwell Mun. Bldg.	D. C. Smith, 19 Francisco Ave., W. Caldwell
	Jersey City	†Revere Boys Club	7:15, Mon., Tue.	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
	Teaneck	†Bergen Co. A.S.	8:30, 2nd Wed.	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
NEW YORK	Buffalo	†*A.T.M.s & Observers	7:30, 1st, 3rd Wed.	Mus. of Science	Dr. F. S. Jones, 83 Briarcliffe, Cheektowaga
	New York	*A.A.A.	8:00, 1st Wed.	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., EN 2-8500
	New York	†Junior A.C.	7:30, 4th Fri.	Amer. Mus. Nat. Hist.	J. Rothschild, Hayden Plan., EN 2-8500
	Rochester	†Rochester A.C.	8:00, Alt. Fri.	Rochester Museum	H. O. Woodard, 485 Hayward Ave. (9)
	Schenectady	†S'tady A.C.	8:00, 3rd Mon.	Schenectady Museum	Miss Betty Douglas, 714 Altamont Ave.
	Utica	†*Utica A.A.S.	7:30, 4th Tue.	Proctor Inst.	John Zimm, 239 Thieme Pl.
	Wantagh	Long Island A.S.	8:00, Sat.	Private homes	A. R. Luechinger, Seaford Ave., 1571
N. CAROLINA	Greensboro	†*Greensboro A.C.	8:00, 1st Thu.	Woman's Coll., U.N.C.	Mrs. Z. V. Conyers, 210 W. Fisher Ave.
	Raleigh	†Astronomical Soc.	....	N. C. State Coll.	C. F. Campen, Jr., Physics Dept.
	Winston-Salem	†*Forsyth A.S.	7:30, Last Fri.	Private homes	Kenneth Shepherd, 1339 W. 4th St.
OHIO	Akron	*A.C. of Akron	8:00, 2nd Fri.	Beth.-Luth. Church	Mrs. R. J. Couts, 878 Kennebec Ave. (5)
	Cincinnati	*Cin. A.A.	8:00, Various days	Cincinnati Obs.	E. D. Funck, Cin. Observatory (8)
	Cincinnati	*Cin. A.S.	8:00, 3rd Wed.	5556 Raceview Ave.	John Dann, 3318 Felicity Dr. (11)
	Cleveland	†Cleveland A.S.	8:00, Fri.	Warner & Swasey Obs.	Mrs. S. K. Towson, Warner & Swasey Obs.
	Columbus	*Columbus A.S.	8:00, Last Tue.	McMillin Obs.	J. A. Hynek, Ohio State Univ.
	Dayton	A.T.M.s of Dayton	Eve., 3rd Sat.	Private homes	F. E. Sutter, RR 7, Box 253A (9)
	Lorain-Elyria	Black River A.S.	8:00, 2nd Mon.	Clearview School	Louis Rick, Box 231, Lorain
	Toledo	Toledo Ast. Club	....., 3rd Tue.	Univ. of Toledo Obs.	E. D. Edenburn, 4124 Commonwealth Ave.
	Warren	†Mahoning Val. A.S.	8:00, Thu.	Private homes	S. A. Hoynos, 1574 Sheridan, NE, 25034
	Youngstown	*Y'town A.C.	7:30, 1st Fri.	Homestead Pk. Pav'n.	F. W. Hartenstein, 905 Brentwood
OREGON	Portland	†*Portland A.S.	7:00, 1st Wed.	Central Pub. Lib.	H. J. Carruthers, 427 S. E. 61 Ave.
	Portland	†A.T.M. & Observers	8:00, 2nd Tue.	Private homes	N. C. Smale, 831 N. Watts St.
PENNSYLVANIA	Beaver	†*Beaver Co. A.A.A.	8:00, 4th Tue.	Com'y Bldg., Tamaqui	Mrs. R. T. LuCaric, Box 463, Baden
	Philadelphia	†A.A. of F.I.	8:00, 3rd Fri.	Franklin Institute	Edwin F. Bailey, RIT 3050
	Philadelphia	*Rittenhouse A.S.	8:00, 2nd Fri.	Morgan Physics, U. Pa.	Sarah Lippincott, Sproul Obs., Swarthmore
	Pittsburgh	†*A.A.A. of P'burgh	8:00, 2nd Fri.	Buhl Planetarium	Charles H. LeRoy, R.D. 11 (15)
RHODE ISLAND	Providence	Skyscrapers, Inc.	8:00, Mon. or Wed.	Ladd Observatory	Ladd Obs., Brown U., Jackson 1-5680
S. CAROLINA	Columbia	North'n Cross A.S.	8:15, Every Mon.	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
TENNESSEE	Chattanooga	*Barnard A.S.	8:00, 3rd Fri.	Jones Observatory	C. T. Jones, 302 James Bldg., 7-1936
	Nashville	*Barnard A.S.	7:30, 2nd Thu.	Vanderbilt Univ.	Miss J. Saffer, 446 Humphrey St. (10)
TEXAS	Dallas	†Texas A.S.	8:00, 4th Mon.	Various auditoriums	E. M. Brewer, 5218 Morningside, U6-3894
	Ft. Worth	†*Ft. Worth A.S.	8:00, 4th Fri.	Texas Christian U.	L. C. Eastland, 5501 Byers Ave. (7)
	Houston	Houston A.S.	7:30, Last Fri.	Mus. Nat. Hist. Annex	Mrs. J. Murray, 1007 W. Gray (6)
	Port Arthur	†Port Arthur A.C.	....., 2nd Tue.	Private homes	G. van den Berg, Box 266, Groves
UTAH	Salt Lake City	A.S. of Utah	8:00, 2nd Fri.	City and County Bldg.	Junius J. Hayes, 1148 East 1 S.
VERMONT	Springfield	†Springfield T.M.s	6:00, 1st Sat.	Stellafane	John W. Lovely, 27 Pearl St., 535-W
VIRGINIA	Norfolk	†*A.A.S. of Norfolk	8:00, 2nd, 4th Thu.	Museum of Arts	A. Hustead, U.S. Weather Bureau, 21745
	Richmond	†Richmond A.S.	8:00, 1st Tue.	Builders Exchange	Miss L. Sievers, 4018 Clinton Ave. (27)
WASHINGTON	Spokane	*A.T.M.s of Spokane	....	.....	D. K. Johnson, 301 S. 15th, Coeur d'Alene, Id.
	Tacoma	Tacoma A.A.	8:00, 1st Mon.	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 N. Union Ave.
	Yakima	†*Yak. Am. Ast'mers	8:00, 2nd Mon.	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.
WISCONSIN	Beloit	Beloit A.T.M.s Club	....., Alt. Thu.	YMCA Bldg.	Kenneth W. Schultz, 959 Johnson St.
	Madison	†Madison A.S.	8:00, 2nd Wed.	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
	Milwaukee	†*Milw. A.S.	8:00, 2nd Mon.	Public Museum	E. A. Halbach, 2971 S. 52 St., W. Allis



The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of September, respectively.

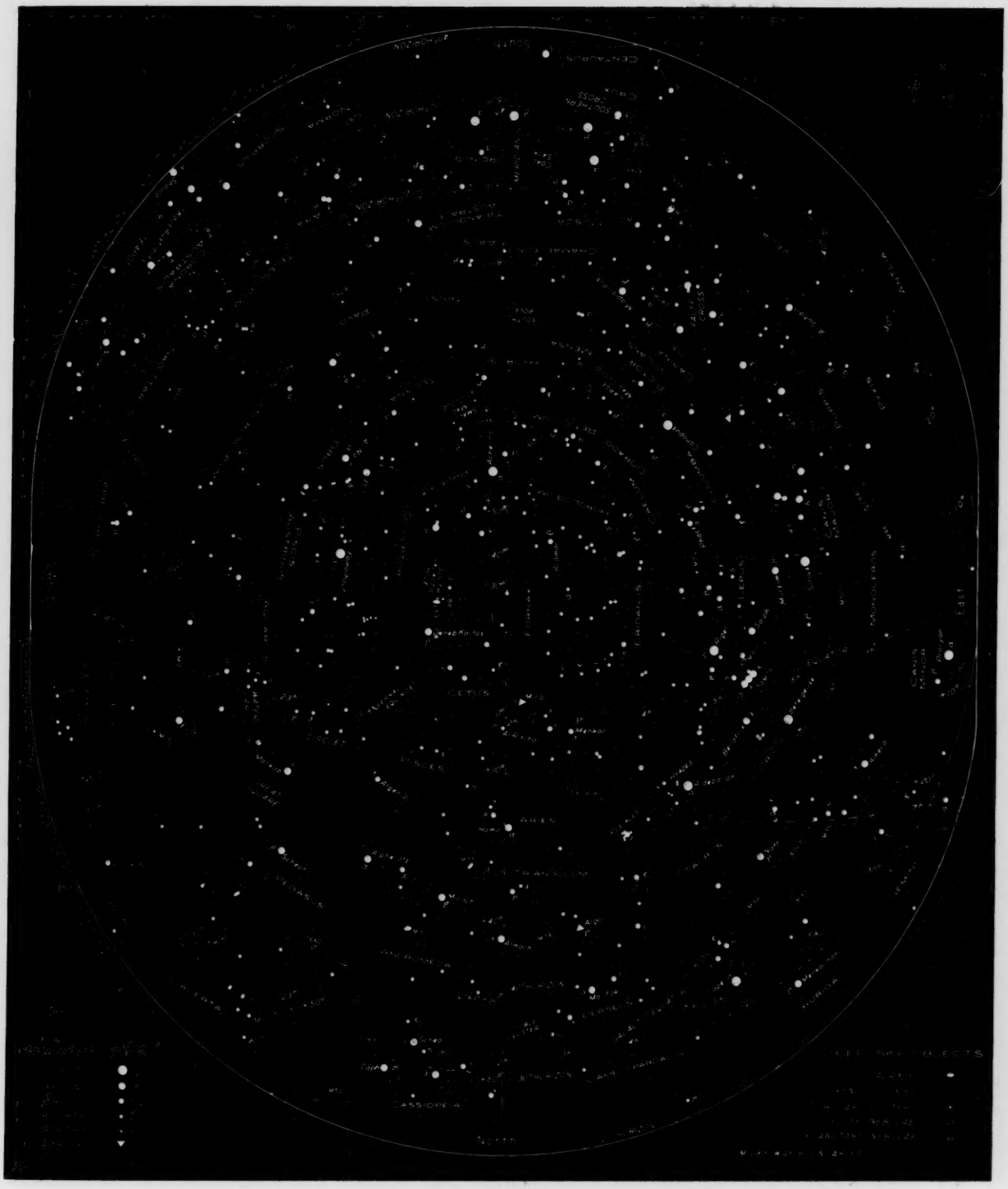
STARS FOR SEPTEMBER

CYGNUS, THE SWAN, flies high overhead during September. Although it was known as a bird to most of the ancients, Eratosthenes first called it Cycnus, name of a mythological son of Mars. Modern observers, however, often refer to the bright stars as the Northern Cross, with Deneb at the head and Albireo in the foot. The central star is Sadr, and Epsilon Cygni in the east arm is Gienah; the west arm is Delta.

Sir William Herschel counted no less than 331,000 stars within five degrees near Sadr. A pair of binoculars reveals many banks and rifts of stars throughout the constellation. The fine condensation associated with the North America nebula area just east of Deneb is a rewarding sight indeed.

The 5th-magnitude star, 61 Cygni, once famed as the nearest visible to northern observers, is between the two stars northeast of Gienah, nearer the easternmost. Its distance of 11.1 light-years places it beyond Sirius at 8.6 light-years, Procyon at 11.0 light-years, and several fainter competitors. However, 61 Cygni is still the closest naked-eye star in the summer.

CHART CORRECTION: In this chart the Greek letters for Alpha and Beta Cassiopeiae should be exchanged.

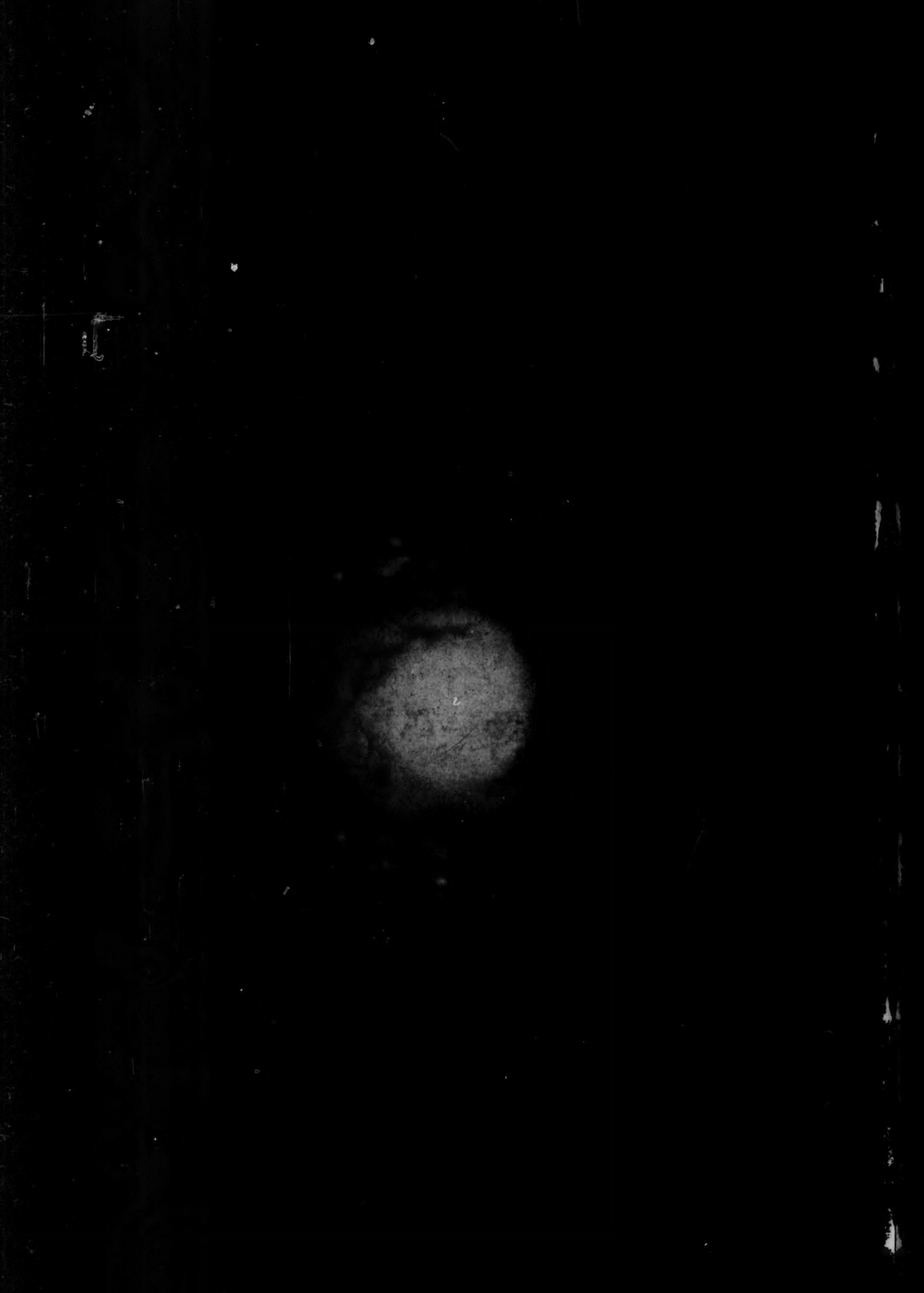


The sky as seen from latitudes 20° to 40° south, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of December, respectively.

SOUTHERN STARS

THE SOUTH GALACTIC POLE lies close to the zenith during the summer months for many Southern Hemisphere observers. The Milky Way extends more than halfway around the horizon, highest in the east. Overhead the decreased population of stars is apparent.

Fomalhaut, Achernar, and Canopus, three 1st-magnitude stars lying nearly on a line, provide guideposts for the December observer. Between them lie several small constellations, some of which are now abbreviated from longer names assigned in the 17th and 18th centuries.

Sculptor, once Apparatus Sculptoris, the Sculptor's Workshop, and the mythical bird, Phoenix, appear between Fomalhaut and Achernar. Horologium, the Clock, and Dorado, the Goldfish, lie between Achernar and Canopus. Reticulum Rhomboidalis has fortunately been shortened to Reticulum, the Net, and Equuleus Pictoris, the Painter's Easel, is now known merely as Pictor.

In the northern sky are two other small constellations, familiar to northern observers. Aries, a zodiacal constellation featuring the 2nd-magnitude star Hamal, and Triangulum, noted primarily for the telescopic spiral, M33, take positions on the northern meridian.